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No 1

MALIGNANT EPITHELIAL TUMORS OF THE NECK OF UNKNOWN ORIGIN

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THERE are probably no surgical conditions more difficult to diagnose clinically than malignant epithelial tumors of unknown origin located in the neck. In a series of twenty-four such cases admitted to the First Surgical Division of Bellevue Hospital, New York City, the correct diagnosis of carcinoma or epithelioma was infrequently made. The usual diagnosis in these cases was either Hodgkin's disease or lymphosarcoma, though occasionally they were thought to be either a parotid tumor or a tuberculous lymph node.

In this series of cases from the adult surgical service of the First Division the tumors were either excised or tissue was removed for biopsy. Unfortunately all these cases were not followed up, and but few came to necropsy.

The origin of these tumors is little understood and is largely a matter for academic discussion. As their microscopic picture does not indicate their origin, it is impossible to determine whether they arise primarily from some vestigial structure or secondarily from some unknown focus.

Historical—Relatively little has been written about malignant epithelial tumors of the neck, yet they appear to be a distinct type. In 1882 Richard Volkmann¹ in his paper "Das Branchiogene Hals Karcinoma" first described branchiogenetic carcinoma. In the ten years previous he had seen only three of these cases. They were not secondary to a primary focus elsewhere, nor did they arise from the lymph nodes. They all occurred in men between forty and fifty years, and occurred more frequently on the left than on the right side. They were at first of firm, scirrhous consistency, but later underwent a mucoid softening that gave them the consistency of a fluctuating tumor. The growth was usually very extensive, reaching upward to the base of the skull and involving the great vessels of the neck and the larynx, this latter involvement resulting in respiratory distress. The skin was not attached to the mass, but was usually raised in folds. He describes in detail two cases, one of which had a large, fluctuating, inoperable mass that eroded the carotid artery and caused death by hæmorrhage, while in the second there was a large, dense tumor behind the hyoid bone, involving the great vessels of the neck and the pharynx. He emphasizes the difficulties to be met with in the excision of this tumor. He says that microscopically these tumors are of the squamous-celled cornifying epithelial type, "hornkrebs" with isolated areas of cylindrical epithelium the stroma being very thick and sclerotic. He states that the general opinion is that these tumors arise from remnants of the branchial cleft and remain quiescent until stirred into activity by some unknown irritation. He also connects these tumors with branchial cysts, or branchiogenetic chondromata, and closes with the suggestion "We surgeons must in general believe in Cohnheim's theory that tumors from embryonic rests are usually benign." Volkmann had not seen subcutaneous carcinoma in the usual sites of embryonic rests with the exception of the three tumors noted. Tinker² collected from different sources fifteen malignant epithelial tumors of branchial cleft origin.

Cohn³ quotes Coley whose opinion was based on 167 cases of malignant tumors of the neck, that the most common variety is round-cell sarcoma. Cohn mentions the relative frequency of carotid body tumors.

McKenty⁴ collected from the Royal Victoria Hospital, Montreal, five undoubted cases of branchiogenetic carcinoma. He emphasizes their rapidity of growth and their site as being behind and below the angle of the jaw. Pain, though frequently absent in early cases, is usually severe and caused by involvement of nerves. He considers that epitheliomas of the neck that do not involve the skin or mucous membrane, and for which no primary focus can be found elsewhere, should be looked upon as branchiogenetic carcinoma. He emphasizes the necessity of a thorough examination of the mouth, pharynx and larynx, "as a growth not as large as a split pea" may give rise to very extensive metastases.

Ewing⁵ states that these tumors usually occur after forty, that they may be globular, cystic or solid, and are usually of cystic growth. He raises the question as to how many of these malignant neoplasms of the neck of obscure origin are referable to branchial rests. He thinks this is not determined, but feels, however, that in all secondary carcinomas it should be possible to demonstrate the primary growth, and that the structure of these neoplasms is commonly that of an adult acanthoma.

Carp and Stout⁶ think that branchiogenetic carcinoma is rare as they collected but four cases from the Presbyterian Hospital, New York City. Evidently it is their opinion that the majority of these tumors are secondary to some other site. It is their contention "that even in autopsy is not conclusive" as the primary site may have been overlooked.

Hudson⁷ states that the prevalent opinion on malignant epithelial tumors of the neck is that they are divided into two groups—those made up of squamous epithelial cells that are secondary to a healed or undiscovered focus, and those arising from vestigial remnants, which are uncommon. The latter neoplasms occur in two main types: (a) branchiogenetic carcinoma and (b) endothelioma, the latter tumor having a structure similar to that of an endothelioma of the salivary glands. At the Middlesex Hospital there were ten of these cases during the ten years covered by Hudson's paper. It is his opinion that these tumors arise in the jugulo-digastric lymph glands, an oval, flattened structure about 2.5 centimetres in length, which is situated on the mesial aspect of the great jugular vein and extends from the posterior belly of the digastric muscle to the tip of the superior cornu of hyoid bone. This is the main drainage station for the external auditory meatus, Eustachian tube, nasopharynx, tonsils, tongue and epilaryngeal structures.

Because of the extreme malignancy of these tumors and their surgical importance, a study of the unusually large number of cases available in the Bellevue series may be found of value.

Sex and Age—Of the twenty-four cases, eighteen were those of males and six those of females. The average age was forty-seven, the oldest sixty-eight, the youngest thirty-seven years, and only three under forty. Apparently neither sex nor age is a determinative factor, as the males among these cases averaged fifty years of age, and the females forty-five.

Duration—In the majority of the cases the average duration of symptoms was somewhat less than four months, with an extreme variation in one case of two years, and in another of one week.

Site—A few of the patients showed a bilateral involvement with a ratio of six to eighteen. In a unilateral involvement the left side predominated—thirteen to five. With but few exceptions these tumors arose in a rather restricted area, namely, around the angle of the lower jaw. This position

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corresponds to that of the jugulo-digastric gland of Hudson's, or the great jugular lymph node as it is more commonly named by anatomists. As will be shown later, the position of this tumor and its intimate relationship to the great vessels of the neck are of the utmost importance from the operative point of view.

Probable Site of Origin—In only three instances were there any definite signs suggestive of a primary site elsewhere in the body. In one case the left tonsil presented a tender, small, indurated area that clinically resembled an epithelioma, but as tissue was not excised for biopsy the diagnosis was not confirmed. The second showed an indurated, ulcerated area in the gum of the lower jaw, with a direct extension from this to the tumor at angle of mandible. Evidently it was a primary epithelioma of the gum. The third case gave a suggestive history, but rather indefinite physical signs of an intra-abdominal tumor in the left lower quadrant. Unfortunately this case did not come to necropsy.

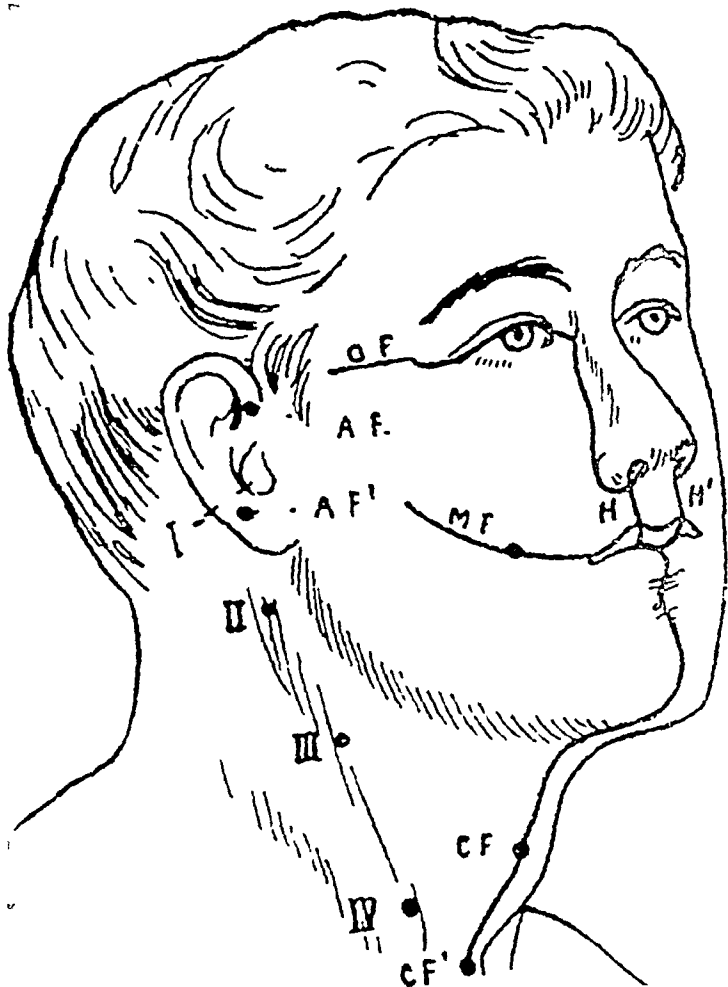


FIG. 1.—Site of bronchial clefts in neck II, III, IV (Bland). Most of the malignant neoplasms arise at site II.

How many of these tumors arose from some primary focus other than the neck is purely a question for speculation, but certainly if they did arise elsewhere, the most careful physical examination failed to reveal it.

It is evident that to be able to determine with any degree of accuracy the origin of these tumors is of great surgical importance. For if they are primary, one might consider the advisability of an operation with some hope of success, but if they are but the external signs of some remotely placed malignant growth the prognosis is not encouraging. In considering this question it must be borne in mind that in our series with the exceptions noted, no primary focus, elsewhere in the body, was ever definitely proven. It would be, therefore, in our opinion, not unreasonable to assume that at least a certain percentage of these neoplasms do arise primarily in the neck from some small epithelial nest.

Symptoms—The history is usually the same. The tumor grows without symptoms until it has reached sufficient size to be seen and felt. The condition is a progressive one with the mass gradually, in most instances, increasing in size, but in some cases it grows with extreme rapidity. Pain is a variable factor and occurs in over half of the cases, when present it is severe and described as being sharp and shooting. Respiratory distress and dysphagia were present

in a considerable number of instances. The presence or absence of these symptoms is a good indication of the amount of involvement, when present one must assume that the growth is diffusely infiltrating, when absent, that it is probably circumscribed. It is quite obvious that where the involvement is bilateral the symptoms are more marked than when unilateral.

Physical Signs

—In most instances these tumors occupied an area immediately posterior to the angle of the jaw in the region of the great jugular lymph node (Fig 2). The

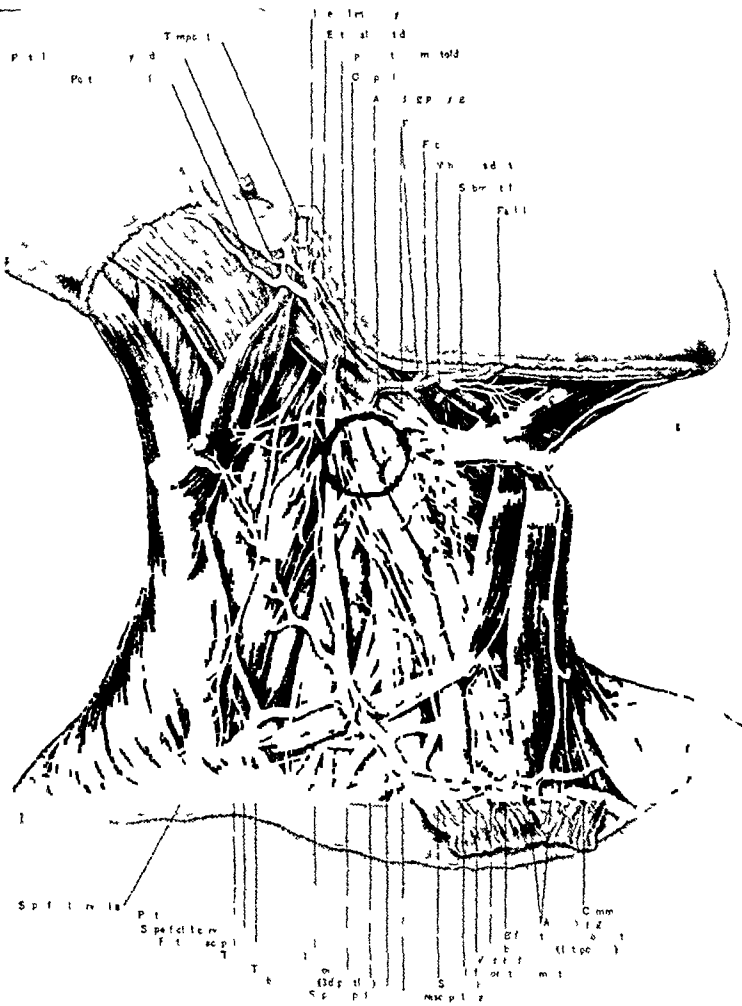


FIG 2—Anatomy of neck (Deaver⁹). The circle indicates the approximate position of all the tumors discussed in this article.

mass was usually large, either smooth or lobulated and of firm and dense consistency. The tumor was attached rarely to the skin, but frequently to the deeper structures. Occasionally the growth involved both the deep and superficial structures and not infrequently, when this occurred, the skin over the surface was red, swollen and tender. As these physical signs were more suggestive of an abscess than they were of malignancy, the latter condition was frequently unsuspected. Tenderness, except in diffuse growths may or may not be present.

Differential Diagnosis—The problem of differentiating these malignant

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tumors from other masses in the neck is one of extreme difficulty Ewing⁵ mentions that they may be confused with carcinoma from aberrant thyroid follicles, tumors of the carotid body and primary endothelioma of lymph nodes Hudson⁷ differentiates them from primary endothelioma of lymph glands, carcinoma of parotid, carotid body tumors and branchiogenetic tumors His differentiation is as follows

- 1 Endothelioma of lymph node when single can be diagnosed only by microscopic section

- 2 In carcinoma of the parotid the tumor is largely confined to the gland and spreads from there to cheek

- 3 Carotid body tumors are situated at a lower level in the neck and are globular and of irregular outline

- 4 Branchiogenetic tumors arise from preexisting cysts, are cystic in some parts, and occur at a lower and more medial level

In the First Surgical Division of Bellevue Hospital, on adult surgical service, all the tumor-like masses of the neck, other than those of the thyroid and obvious metastases, were in their indicated order of frequency of the following kinds This series of 177 cases includes those from which tissue was removed for sectioning, and covers a period of ten years, 1919-1928 inclusive

	Per cent
Tuberculosis	56
Epithelioma, unknown origin	14
Mixed tumors of parotid	7.5
Lymphosarcoma	6.5
Branchio- and thyroglossal cysts	6
Hodgkin's disease	4

We appreciate that the surgical conditions and their order of frequency, as given in the above table, may not correspond to the findings in similar wards of other hospitals, but because of Bellevue's acute surgical service and enormous turnover of patients, they no doubt are a fair sample of surgical conditions in general In our experience the clinical diagnosis of malignant epithelioma of the neck cannot be made with any degree of certainty However, a hard, fixed tumor of comparatively rapid growth, situated somewhat behind and below the angle of the jaw, must always be regarded with grave suspicion until its character has been proven by microscopic section

Prognosis—As far as we know the follow-up on these cases, in all hospitals, is exceedingly discouraging McKenty⁴ in his series from the Royal Victoria Hospital has a mortality of 100 per cent In Hudson's⁷ six cases, four died within eleven months, while the follow-up on the remaining two was of too short duration to be of any value Unfortunately, in most of our cases the follow-ups were incomplete, but we feel justified in assuming that the ultimate result, with possibly a few exceptions, was as hopeless in the unfollowed cases as it was in those that were followed This assumption offers for evidence the fact that most of these cases were inoperable when first seen and rapidly progressive when lost track of

Pathology—Macroscopic—In most of the Bellevue cases the neoplasm had advanced to such an extent that the specimens removed were only for biopsy, either in the form of enlarged lymph nodes or fragments from the tumor itself. Involved lymph nodes usually showed rather extensive areas of degeneration surrounded by masses of soft, homogeneous tissue. In certain areas the nodes were not degenerated, but on the contrary solid and of a rather firm consistency. The tumors excised varied in size, but usually averaged from seven to four centimetres in diameter. Most of them were

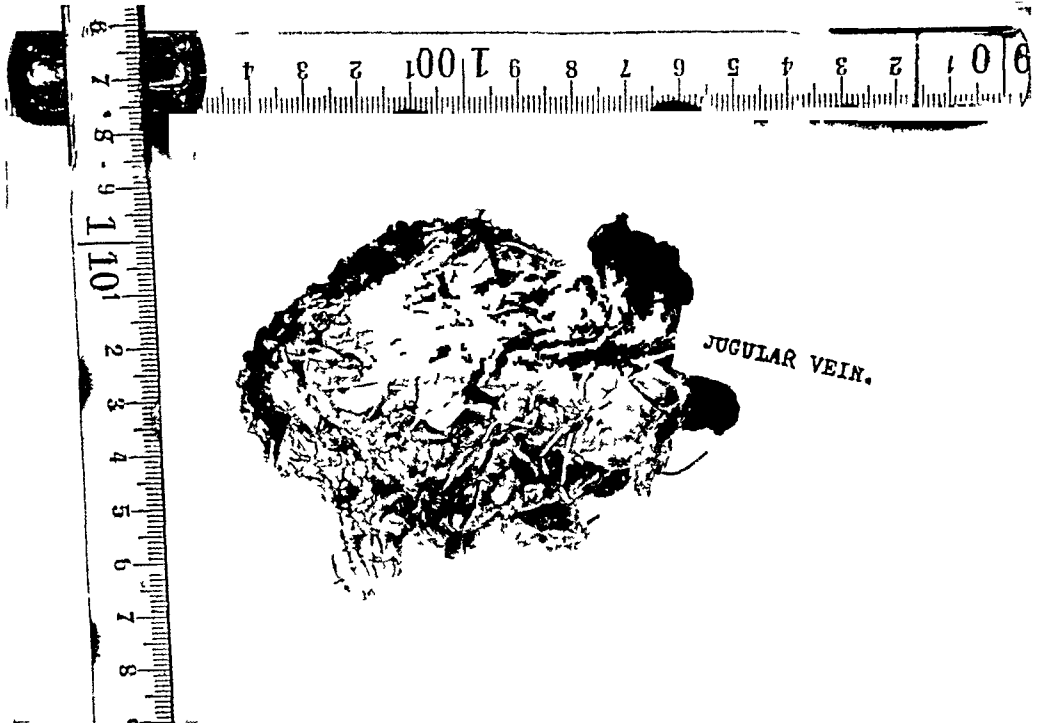


FIG 3—Case IV Gross specimen of circumscribed mass surrounding internal jugular vein

circumscribed and appeared to be encapsulated. They were either globular in shape, lobulated, or had a distinctly nodular appearance. From the shape of these tumors and their apparent encapsulation, one is frequently amazed at the amount of adjacent tissue involved.

In one recent case the tumor surrounded and was intimately adherent to most of the great vessels of the neck, and had infiltrated inward to the pharynx and downward almost to the supraclavicular fossa. In addition, the cervical lymph nodes on the opposite side were extensively involved. (See chart, case IV, and Fig 3.)

On section all of our tumors were of firm consistency throughout, the cut surface being smooth and of a rather homogeneous appearance. In not a single specimen was there any evidence of cyst formation. This might well raise the question as to whether the tumors excised were primary growths or secondary involvement of lymph nodes. Neither from the gross specimen nor microscopic section could this be determined with any degree of certainty. The above findings again introduce the subject of their origin. For if, as has

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been suggested by Ewing, Hudson and others, most branchiogenetic carcinomas arise from a preexisting cyst, then it is evident that this statement is either incorrect or that our tumors were not of branchiogenetic origin, or the masses removed were secondary growths and not the primary focus. This seems to be a question that is little understood, rather a matter for speculation and one that cannot be proven.

Microscopic—The histological make-up in our series of tumors was in



FIG 4 —Photomicrograph, low power, showing usual arrangement of cells in most of the neoplasms in this series

most ways similar to that described by Volkman,¹ McKenty⁴ and Hudson.⁷ usually consisted of a mass of more or less undifferentiated epithelial cells. In some cases these cells were more highly differentiated and resembled rather closely squamous epithelium, but on the whole they tended toward the embryonal type with cells that were rather large and of irregular shape, though somewhat columnar. The cytoplasm was rather scanty and stained poorly, while the nuclei were large, prominent, highly chromatic and showed many mitotic figures. Practically without exception the Bellevue series of tumors showed a very definite cellular arrangement. This constant pattern was that of a network of epithelial cells, arranged in strands of various breadths, together with a very marked tendency of these cells toward an alveolar arrangement. In many instances these tumors in addition to this

formation showed, in areas the cells massed together in the form of sheets, these structureless masses resembling closely syncytium. Because of the tendency of these tumors in their growth to form a more or less complex network, they might, if one chose to use a descriptive term, be called plexiform epithelioma. The connective-tissue stroma varied considerably in the different tumors, but as a general rule it was very cellular, so much so, in fact that in certain areas it closely resembled a spindle-celled sarcoma. This

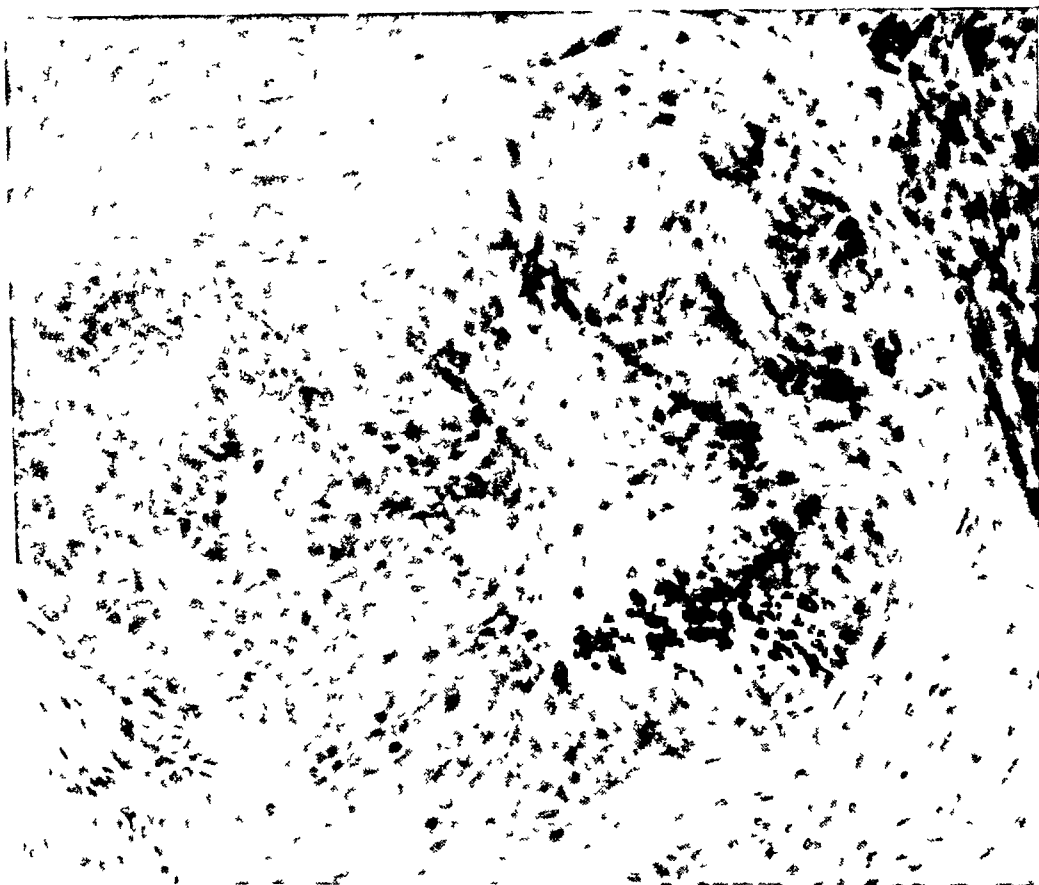


FIG. 5.—Photomicrograph high power showing tendency of cells to columnar shape and attempt at alveolar arrangement

cellular character of the stroma appeared to indicate the rapidity of the growth. For the more cellular and undifferentiated the cells, the more diffuse and rapidly growing was the tumor, while the more differentiated and adult the connective tissue the less rapid and more circumscribed the growth appeared. Another marked and outstanding feature, in a very large percentage of these tumors, was the amount of necrotic or degenerated tumor tissue. Naturally this varied considerably in the different cases, the controlling factor seemingly depending upon the rapidity of growth. In common with other rapidly growing malignant neoplasms, these tumors were, as a general rule, very vascular.

Diagnosis—For want of a better name we have called these neoplastic growths malignant epithelial tumors of the neck. As their origin is unknown,

any further attempt at a classification would be without value and a mere matter of juggling words. However, for purposes of record and filing some nomenclature that in a measure describes the microscopic picture, such, for example, as plexiform epithelioma or alveolar epithelioma, would, perhaps, serve the purpose quite as well as any other term.

Treatment—Of all the difficult problems which from time to time the surgeon is forced to face, there is, perhaps, none more difficult than the

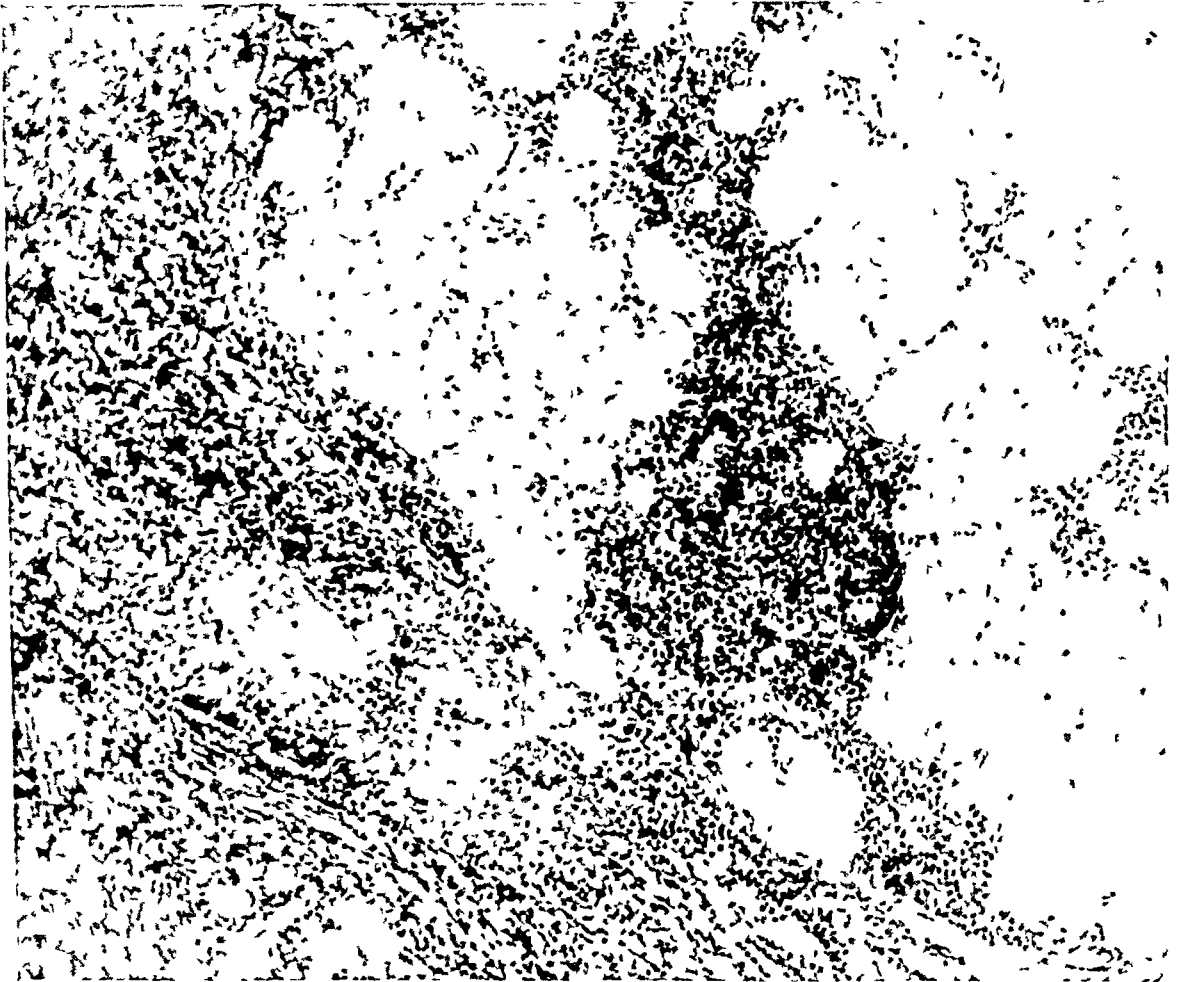


FIG 6 —Photomicrograph, low power, showing slight alveolar arrangement and mass of undifferentiated cells invading muscle

proper treatment of these tumors. The first problem to be solved is that of diagnosis, which in most instances cannot be made clinically, but is dependent upon the biopsy. Having arrived at a diagnosis, the next question for discussion is whether or not this growth is primary or secondary. If primary, small and localized, one might well consider the proper procedure to be that of excision. If, however, this local growth be but secondary to some deeply seated primary focus, then an excision if the symptoms warrant it, must be considered a palliative measure and not a cure.

This decision is of sufficient importance to make it worthy of very serious consideration. In most instances, due to lack of knowledge, it probably cannot be made. There are, however, a sufficient number of malignant tumors arising elsewhere in the body and occasionally metastasizing, to the cervical

lymph nodes to make all deeply seated epithelial growths in this region open to suspicion. For these reasons it is our opinion that an operation should only be considered after a careful, physical examination has failed to reveal a primary focus elsewhere. On the other hand, when considering the treatment of these neoplasms one must not overlook the probability that many of them may be primary in the neck, and unless we have evidence to the contrary it is not reasonable to assume that they all must be secondary.

There is one more point that arises relative to the advisability of an operation and that is the position of these tumors. The majority are rather deeply seated, usually diffusely invasive, and are intimately connected with the great vessels of the neck. This makes the operation one that requires considerable technical skill and an intimate knowledge of the local anatomy.

In the treatment of this condition it may be of interest to briefly mention the experiences of McKenty and that of Hudson. McKenty¹ considers these tumors highly malignant and an operation is not a satisfactory form of treatment. Hudson⁷ believes that in a great majority of cases surgical excision is uniformly disappointing and recurrence usually rapid and fatal, and considers the operation difficult and hazardous, and advises, for want of a better therapeutic measure, the use of radium.

Our experience agrees with these authors, for we do not believe that a surgical excision can be looked upon as a cure, and we are somewhat skeptical as to the value of radium. Certain exceptions must be taken to the statement regarding the inadvisability or futility of an excision. In a few instances where the tumor is rather small and evidently encapsulated or circumscribed, it might well be a primary growth. In that event an excision would be, by all means, the treatment of choice, but in our series it could seldom be considered for in the vast majority of cases the tumor was inoperable when first seen. Of the two methods of treatment we would, as a general rule, recommend radiation, for an excision, excepting in a few rare cases, seems to stimulate the tumor's growth rather than retard it.

SUMMARY

In summation it may be said

1. A study of these cases in an adult surgical service in Bellevue Hospital shows that malignant epithelial tumors of the neck are far more common than is generally supposed, and are frequently mistaken for Hodgkin's disease and lymphosarcoma.

2. That practically all these tumors occupied an area behind and below the angle of the jaw and in the majority of cases were unilateral.

3. That their origin was unknown. Probably some were secondary to a remote primary focus, but this could not be proved.

4. That diagnosis is extremely difficult, in most cases it can be made only by microscopic sections, as the clinical findings are frequently not sufficiently characteristic to differentiate it from other masses in the neck. When a mass located below and behind the angle of the jaw gives a history of a gradual

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of rapid growth, this tumor should always be considered as a possibility

5 That the treatment, either by excision or radiation, seems to be equally unsatisfactory. Excision in particularly favorable cases, or as a palliative measure to relieve symptoms, may at times be considered, but that the difficulties of this operation cannot be overestimated

6 In most cases the prognosis was bad, as the tumor when first seen was inoperable

CASE I—Age fifty-three, male. Admission date, October 9, 1928. Site—Left side of neck, angle of jaw. Duration—One month. Symptoms and Physical Signs—Swelling below angle of jaw, rapidly increased in size, no pain, respiratory distress or dysphagia, tumor mass 5 cm in diameter, adherent to deeper structures, not to surface, no tenderness. Clinical diagnosis—Carcinoma. Pathology, gross and microscopic—Circumscribed mass $7 \times 5 \times 4$ cm. Surface shows a series of discrete nodes, very dense, mass of columnar cells in branching strands showing distinct alveolar arrangement, many mitotic figures. Pathologic diagnosis—Epithelioma. Treatment—Excision and radium. Follow-up recent case

CASE II—Age sixty-one, male. Admission date, October 16, 1928. Site—Left side of neck, angle of jaw. Duration—Three weeks. Symptoms and physical signs—Following slight blow developed pain and noticed swelling of neck, no respiratory distress or dysphagia, tumor 8×4 cm angle of jaw, from mastoid to middle of sternomastoid, attached to deep tissues, tender. Clinical diagnosis—Carcinoma. Pathology, gross and microscopic—Diffuse mass 6×5 cm, cut surface resembles a number of discrete lymph nodes, very dense, diffuse mass of squamous epithelial cells arranged in strands, many pearls and mitotic figures. Pathologic diagnosis—Epithelioma. Treatment—Excision. Follow-up—Died post-operative, cerebral hemorrhage

CASE III—Age sixty-two, male. Admission date, May 15, 1928. Site—Left side of neck, angle of jaw. Duration—Four months. Symptoms and physical signs—Noticed stiffness of neck, later tumor mass, sharp, shooting pain, tumor mass 6 cm in diameter, attached to deep structures, hard and tender. Clinical diagnosis—Carcinoma. Pathology, gross and microscopic—Biopsy, small circumscribed node, mass of columnar cells in branching strands showing alveolar arrangement, many mitotic figures. Pathologic diagnosis—Epithelioma. Treatment—Inoperable biopsy. Follow-up—Progressive, lost

CASE IV—Age sixty-five, male. Admission date, May 10, 1928. Site—Left and right side of neck, angle of jaw. Duration—Five weeks. Symptoms and physical signs—Mass in left and right side of neck rapidly increased in size, tenderness, dysphagia, mass at angle of left and right jaw 7 cm in diameter, tender, attached to deeper structures. Clinical diagnosis—Carcinoma. Pathology, gross and microscopic—Large infiltrating mass 6×5 cm involving vessels of neck, mass of interlacing strands, columnar epithelial cells, alveolar arrangement, many mitotic figures. Pathologic diagnosis—Epithelioma. Treatment—Excision of mass from right and left side. Follow-up—Died post-operative, following excision of mass from right side

CASE V—Age thirty-seven, male. Admission date, February 23, 1928. Site—Right side of neck, angle of jaw. Duration—Ten weeks. Symptoms and physical signs—Noticed mass right side, gradually increased in size, dysphagia, sharp pain, tumor mass at angle of jaw, extensive growth, not attached to surface. Clinical diagnosis—Hodgkin's disease. Pathology, gross and microscopic—Biopsy, mass of broad, branching columnar-shaped cells, having alveolar arrangement, many mitotic figures. Pathologic diagnosis—Epithelioma. Treatment—Tissue for biopsy. Follow-up—October 25, 1928, extensive local recurrence, distant metastases, condition terminal

CASE VI—Age fifty, female. Admission date, February 6, 1928. Site—Left side of neck, angle of jaw. Duration—Two months. Symptoms and physical signs—Mass in neck, no pain, extensive growth, lower angle of jaw, deeply adherent. Clinical diag-

nosis—Metastatic carcinoma Pathology, gross and microscopic—Biopsy, diffuse mass of undifferentiated epithelial cells, slightly suggests glandular arrangement, mitotic figures Pathologic diagnosis—Malignant epithelial tumor Treatment—Lymph node for biopsy Follow-up—Home A O R unimproved

CASE VII—Age sixty-six, male Admission date, September 7, 1927 Site—Left side of neck, angle of jaw Duration—Five months Symptoms and physical signs—Noticed small lump, rapidly increased in size, hoarseness, cough, pain, large, extensive tumor mass fixed to deeper structures, tender Clinical diagnosis—Carcinoma Pathology, gross and microscopic—Biopsy, mass of branching columnar-shaped cells having alveolar arrangement, many mitotic figures Pathologic diagnosis—Epithelioma Treatment—Biopsy, inoperable Follow-up—Transferred to Department of Public Welfare, condition progressive, lost

CASE VIII—Age fifty-six, male Admission date, October 25, 1926 Site—Left side of neck, angle of jaw Duration—Eight weeks Symptoms and physical signs—Tumor mass gradually increased in size, sharp, shooting pain, hard mass 6 cm in diameter, skin over surface red, tender and hot Clinical diagnosis—Parotid tumor Pathology, gross and microscopic—Tissue for biopsy, mass of broad branching strands, columnar-shaped cells having alveolar arrangement, many mitotic figures Pathologic diagnosis—Malignant epithelial tumor Treatment—Biopsy, inoperable Follow-up—Condition progressive, lost

CASE IX—Age forty-five, female Admission date, November 12, 1926 Site—Left side of neck, angle of jaw Duration—Two years Symptoms and physical signs—Mass in neck gradually increased in size, pain, large tumor mass 8 x 2 cm, deeply adherent, tender Clinical diagnosis—Tuberculous lymph nodes Pathology, gross and microscopic—Encapsulated mass 4 x 3 x 2 cm On section firm, cut surface lobulated, mass of epithelial-like cells in broad, branching strands, pigmented areas, mitotic figures Pathologic diagnosis—Melanocarcinoma Treatment—Excision Follow-up—No recurrence at end of eight months

CASE X—Age forty-seven, male Admission date, January 16, 1926 Site—Right side of neck, angle of jaw Duration—Four weeks Symptoms and physical signs—Mass rapidly increased in size, pain and hoarseness, mass in neck 3 x 2 cm, firm, movable, tender Clinical diagnosis—Tuberculous lymph nodes Pathology, gross and microscopic—Biopsy, diffuse mass of epithelial cells in broad strands, alveolar arrangement, mitotic figures Pathologic diagnosis—Epithelioma Treatment—Biopsy, inoperable Follow-up—Unimproved, lost

CASE XI—Age thirty-nine, male Admission date, September 9, 1925 Site—Right side of neck, angle of jaw Duration—Four months Symptoms and physical signs—Tumor mass gradually increased in size, no pain, hard mass about 4 cm in diameter, adherent to deep structures, no tenderness Clinical diagnosis—Tumor of neck Pathology, gross and microscopic—Biopsy, infiltrating mass of glandular epithelium in branching strands having primitive acini, mitotic figures Pathologic diagnosis—Carcinoma Treatment—Biopsy, inoperable Follow-up—Unimproved, lost

CASE XII—Age sixty-seven, male Admission date, February 26, 1925 Site—Right side of neck, angle of jaw Duration—Six months Symptoms and physical signs—Tumor mass rapidly increasing in size, painful, hard, lobulated mass 3 x 6 cm attached to angle of jaw Clinical diagnosis—Sarcoma Pathology, gross and microscopic—Mass of enlarged lymph nodes, diffuse mass of epithelial cells in broad branching strands, many mitotic figures Pathologic diagnosis—Epithelioma Treatment—Partial excision of jaw and lymph glands Follow-up—Died three days post-operative

CASE XIII—Age forty-nine, female Admission date, April 16, 1925 Site—Right side of neck, angle of jaw Duration—Six months Symptoms and physical signs—Tumor mass in neck gradually increased in size no pain, mass below angle of jaw freely movable Clinical diagnosis—None Pathology, gross and microscopic—Encapsulated mass 2.5 cm in diameter, firm, with necrotic areas, diffuse mass epithelial cells in strands

EPITHELIAL TUMORS OF THE NECK

with alveolar arrangement, necrotic areas, mitotic figures Pathologic diagnosis—Malignant epithelial tumor Treatment—Excision Follow-up—No recurrence seventeen months later

CASE XIV—Age thirty-eight, female Admission date, August 6, 1925 Site—Left and right side of neck, angle of jaw Duration—Seven months Symptoms and physical signs—Noticed mass in left and right side, rapid increase in size, dysphagia, cough and hoarseness, no pain, large adherent mass both sides, many enlarged glands Clinical diagnosis—Hodgkin's disease Pathology, gross and microscopic—Mass 15 cm in diameter, degeneration of extensive areas, strands of undifferentiated epithelial cells, alveolar arrangement, mitotic figures Pathologic diagnosis—Carcinoma Treatment—Tissue for biopsy, inoperable Follow-up—Condition progressive

CASE XV—Age forty-five, male Admission date, June 25, 1924 Site—Left side of neck, angle of jaw Duration—Five days Symptoms and physical signs—Noticed painful swelling in neck, hard, movable mass 2 cm in diameter, surface hot and tender Clinical diagnosis—Fibrosarcoma Pathology, gross and microscopic—Several large lymph nodes, centre necrotic, mass undifferentiated epithelial cells, mitotic figures Pathologic diagnosis—Epithelioma Treatment—Excision Follow-up—Following excision, prompt and extensive recurrence in two months

CASE XVI—Age forty-two, female Admission date, February 27, 1924 Site—Right and left side of neck, angle of jaw Duration—Five months Symptoms and physical signs—Mass gradually increased in size on both sides of neck tumor mass on both sides, very dense, freely movable Clinical diagnosis—Lymphosarcoma Pathology, gross and microscopic—Large mass 5 x 3 cm very firm, strands of columnar epithelial cells, alveolar arrangement, mitotic figures Pathologic diagnosis—Malignant epithelial tumor Treatment—Excision and X-ray Follow-up—Prompt recurrence in two months, extensive bilateral involvement, died following second operation

CASE XVII—Age fifty-seven, male Admission date, March 7, 1924 Site—Left side of neck, angle of jaw Duration—Seven weeks Symptoms and physical signs—Tumor mass, rapid growth, pain and cough, tumor 7 cm in diameter, very dense Clinical diagnosis—Carcinoma Pathology, gross and microscopic—Circumscribed mass 7 x 5 x 3 cm firm, degenerated areas, strands of epithelial cells, alveolar arrangement, many mitotic figures Pathologic diagnosis—Epithelioma Treatment—Partial excision Follow-up—Recurred in two months, ulcerated and progressive

CASE XVIII—Age forty-six, male Admission date, January 12, 1923 Site—Right side of neck, angle of jaw Duration—Three months Symptoms and physical signs—Mass in neck, rapid growth, marked loss of weight, tumor mass in neck, adherent to deep tissues, tender Clinical diagnosis—Metastatic tumor Pathology, gross and microscopic—Enlarged, firm lymph nodes, infiltrating mass epithelial cells, tendency toward glandular arrangement Pathologic diagnosis—Carcinoma Treatment—Inoperable biopsy Follow-up—Condition progressive, referred to St Rose's Home for incurables

CASE XIX—Age sixty-eight, male Admission date, March 13, 1923 Site—Left side of neck, angle of jaw Duration—One year Symptoms and physical signs—Mass in neck, rapid increase in size, pain and dysphagia, diffuse tumor mass, adherent to deep and superficial structures Clinical diagnosis—Malignant tumor Pathology, gross and microscopic—Biopsy, diffuse mass epithelial cells Pathologic diagnosis—Carcinoma Treatment—Inoperable biopsy Follow-up—Progressive, lost

CASE XX—Age fifty-nine, male Admission date, March 24 1922 Site—Left side of neck, angle of jaw Duration—Six months Symptoms and physical signs—Tumor gradually increased in size, pain, dysphagia, mass 5 x 8 cm adherent to deep structures hard and tender Clinical diagnosis—Tumor of neck Pathology, gross and microscopic—Biopsy, mass epithelial cells arranged in strands mitotic figures Pathologic diagnosis—Malignant epithelial tumor Treatment—Inoperable biopsy Follow-up—Condition progressive, lost

CASE XXI—Age sixty-five, male Admission date, July 3, 1922 Site—Right side of

neck, angle of jaw Duration—Four months Symptoms and physical signs—Mass, rapid growth, pain, tumor mass 6 cm in diameter, ulcerated on surface, tender Clinical diagnosis—Carcinoma Pathology, gross and microscopic—Biopsy, mass epithelial cells arranged in strands, many mitotic figures Pathologic diagnosis—Epithelioma Treatment—Inoperable biopsy Follow-up—Referred to General Memorial Hospital, lost

CASE XXII—Age fifty-two, male Admission date, August 18, 1922 Site—Left and right side of neck, angle of jaw Duration—One and one-half years Symptoms and physical signs—Mass gradually increased in size, recent, rapid growth, mass attached to deep structures hard and tender Clinical diagnosis—Sarcoma Pathology, gross and microscopic—Infiltrating, hard mass 7 x 5 x 5.5 cm, mass epithelial cells arranged in strands, mitotic figures Pathologic diagnosis—Epithelioma Treatment—Excision Follow-up—Condition unimproved Referred to Home for Incurables

CASE XXIII—Age forty-two, female Admission date, February 28, 1921 Site—Left side of neck, angle of jaw Duration—Five months Symptoms and physical signs—Tumor was excised, rapid recurrence in scar, tumor at site of scar Clinical diagnosis—Hodgkin's disease Pathology, gross and microscopic—Biopsy, mass of undifferentiated epithelial cells in strands showing alveolar arrangement, mitotic figures Pathologic diagnosis—Epithelioma Treatment—Patient operated upon one year ago, radium inoperable biopsy Follow-up—Following excision one year ago and radium, condition now inoperable and progressive

CASE XXIV—Age forty-six, male Admission date, November 29, 1920 Site—Left side of neck, angle of jaw Duration—Two months Symptoms and physical signs—Noticed small mass, rapid increase in size, stony, hard tumor attached to deep structures Clinical diagnosis—Branchiogenetic carcinoma Pathology, gross and microscopic—Firm nodular mass involving vessels of neck, undifferentiated epithelial cells and strands, alveolar arrangement, mitotic figures Pathologic diagnosis—Carcinoma Treatment—Large resection, radium Follow-up—One year later extensive recurrence, now inoperable

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THE MANAGEMENT OF INTRA-ORAL CANCERS AT THE RADIUM INSTITUTE OF THE UNIVERSITY OF PARIS

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THE purpose of this paper is to report the technical details and principles involved in the management of intra-oral cancers at the Radium Institute of the University of Paris, together with certain personal observations, impressions, and comments.

Because all treatment is based upon the histological diagnosis of the cancer, a biopsy is performed upon every tumor as soon as the patient presents himself at this clinic. This is an absolute prerequisite for treatment inasmuch as the authorities believe that even when the diagnosis of cancer is evident, histologic study will reveal information concerning the variety and the radio-sensitivity of the tumor in question, which will be invaluable for post-radiation statistical analyses; furthermore, it contributes to the prognostic evaluation of the tumor and influences the choice of the methods of treatment.

If the tumor has been treated by radium or X-radiation elsewhere, the patient ordinarily is not eligible for admission to the clinic. This is not a hard-hearted policy, because the Curie Foundation is not principally for immediate charity, but for the purpose of bettering the existing methods of cancer treatment and to establish a rational scientific basis for radium therapy. This necessitates the primary treatment of the cancer, otherwise the variable radiation dosage used in other institutions, the lack of the original histologic data, and the factor of acquired radioresistance unite to confuse the radium and X-ray therapist.

If the radiation dosage is great but insufficient, or incorrectly timed or incorrectly spaced, then within six weeks to two months the tumor may develop a radioresistance which persists indefinitely. The statistics of the Radium Institute indicate that the efficiency of the radiation treatments diminishes rapidly with their increasing number. An improper first treatment may render a neoplasm incurable by radiation. Professor Regaud believes that the Röntgen ray is not successful after radium has failed. On the contrary, recurrences after X-radiation are occasionally susceptible to radium treatment. When association of the two modes of radiation is purposely planned, it is advisable to have the Röntgen ray therapy always precede the treatment by radium.

The Regional Classification of Cancers of the Tongue—(a) The dorso-lingual anterior area—"pars anterosuperior linguæ"—situated anterior to the lingual V, formed by the vallate papillæ. (b) The dorso-lingual posterior area—"pars posterosuperior linguæ"—situated behind the lingual V and extending into the fauces and hypopharynx. (c) The inferior lingual area and floor of the mouth—"pars infra-linguæ".

This localization of lingual cancers has been adopted at the Radium Institute for several reasons. The cancers peculiar to these regions have significant variation in histologic structure, they are endowed with different biological qualities and behavior characteristics, the treatment of each group constitutes a different radiological and surgical problem.

The Histological Types of Lingual Cancers—Histologically, the comparative malignancy of the lingual cancers ascends in the following order: dorso-lingual anterior cancer < infra-lingual cancer < dorso-lingual posterior cancer. The exophytic papillary cancers are less malignant than the ulcerative, infiltrative cancers of the same location. For many years Doctors Regaud and Lacassagne have graded the histological characteristics of tumors in a manner somewhat similar to the method which has become recently popularized as "Bioder's Index of Malignancy." In their conservative way they do not attach undue significance or value to this finding, because of the observation that in some instances biopsies from different parts of the same tumor may show several different degrees of cellular differentiation.

The French school distinguishes between two types of differentiation or cellular evolution of epidermoid carcinomas, namely, a cutaneous and a mucous membrane metamorphosis. Both types occur among the intra-oral group of cancers. The terminal product of keratinization of the type cutaneous consists of sterile squamous sheets, where the protoplasm is changed to keratin or to a substance analagous to keratin. These sheets are end products, they are deprived of nuclei, sometimes this substance is encysted or sequestered in the tissue depths as cornified globules or "pearls." Sometimes this differentiation is complete and typical, sometimes there is failure to differentiate, and in other instances it is atypical or of an intermediate degree. This group of cancers is more common among the epitheliomas of the lip and of the dorsum of the tongue, particularly the cancerization developing on plaques of leucoplakia. In the dorso-lingual posterior and infra-lingual areas the cutaneous type of epidermoid carcinomas is quite uncommon.

The cellular metamorphosis of the type mucosæ begins in the centre of large cords or lobules of epidermoid carcinoma. The nucleated squamifying tissue detaches itself and undergoes autolysis within its cavities, or in the event of failure to evolve the large and clear nucleated cells persist, or if evolution is complete, concentrically lamellated globes or pearls of nucleated cells appear bearing more or less resemblance to the cornified pearls of the cutaneous type.

The lympho-epithelioma of Regaud is a tumor entity of interesting nature. It frequently occurs in the tonsil and base of the tongue. The surface epithelium of the lingual and faucial tonsil lives in close symbiotic relationship with the underlying lymphoid tissue. These epitheliomas usually produce voluminous lymphadenopathies while the primary lesion is barely discernible. Histologically and biologically it is a very malignant tumor.

The Radiosensitivity of Intra-oral Cancers—The comparative radiosensitivity of the lingual cancers ascends in the following order: dorso-lingual

anterior cancer < infra-lingual cancer < dorso-lingual posterior cancer It is definitely established that in the course of its existence a cell or a line of cells (cancer especially) passes through alternating phases of radiosensitivity and radioresistance The cells are particularly radioresistant when for a long time they have been in a state of repose or rest They are most sensitive to the action of radium or X-rays when they have been in a state of mitosis or indirect cell division On account of the double alternating phenomenon of cell reproductive activity Regaud reasons that a short irradiation will destroy only those cells which at the moment are in a state of their maximal radiosensitivity It spares the others On the contrary a longer irradiation for several days destroys all the mother cells successively, because, as the cycle of cellular renovation continues, each cell passes at some time into the phase of maximal sensitivity

Regaud believes that the majority of epidermoid carcinomas are not more radioresistant than the epidermis from which they are derived For the most part the cancers are less radioresistant The dosage for sterilization of cancers of the lip, mouth, and pharynx is from 70 to 100 per cent of the epidermicidal dose The radiosensitivity of intra-oral cancers is diminished by infection This is particularly dangerous in the infra-lingual region Immunization or radio-vaccination of the neoplasm results in acquired radioresistance from the administration of improperly repeated and spaced irradiations

The predominance of cells of the basal type, forming many layers or superimposed strata, is a character which indicates radiosensitivity Per contra, the predominance of polyhedral cells of the same type as the cells of the malpighian layer of the normal cutaneous epidermis indicates relatively feeble radiosensitivity, as these cells are usually in the evolutionary course of keratinization In general it may be said of the radiosensitivity of epidermoid carcinomas that differentiation of the cutaneous type coincides ordinarily with feeble radiosensitivity, whereas the type mucosæ of the same relative degree of differentiation is more highly radiosensitive

The General Principles of Intra-oral Radium Therapy—In America the dosage of radium is expressed in terms of "milligram hours" or "millicurie hours", which is a constant value, being the dose of emission It is easily computed by multiplying the intensity of the radiation (*i e*, quantity, milligrams of radium or millicuries of radium emanation utilized) by the duration in hours of the application The dosage notation used throughout France makes the dose proportional to the quantity of radium destroyed during the course of its application This notation (Debieine and Regaud, 1914, Regaud and Ferroux, 1919) is preferable because it is commodious and equally applicable to tubes of radium or of radon Let us assume that the total therapeutic value of one millicurie of radium emanation is 133 millicurie hours Therefore, one millicurie destroyed is the equivalent of 133 millicurie hours or of 133 milligram hours Or one milligram of radium

acting for 133 hours may be expressed in terms of dosage as one millicurie destroyed

Before treatment is started the teeth are thoroughly cleansed, the necessary dental extractions are performed and pyorrhœa treated. During the course of treatment the mouth is cleansed by daily irrigations with saline or potassium permanganate solution. While radio-active foci are within the mouth, gauze is interposed between the teeth, tongue and cheek for the purpose of avoiding the influence of secondary radiations given off by the teeth.

The hollow needles employed for interstitial curietherapy (radium therapy) are of platinum-iridium, and are charged with emanation throughout their entire length. They are 2.7 and 3.5 centimetres long, 1.5 centimetres thick and have a filtration strength of 0.5 millimetre of platinum. The true focus, *i.e.*, the length occupied by the gas radon, is usually three centimetres long in the longer needle. This gives a cylinder of irradiated tissue rather than a sphere, such as occurs with the use of radon seeds. The maximum amount of emanation in each needle should be not more than two millicuries, sometimes more is used.

Under regional anæsthesia the needles are introduced into the tongue and completely buried there. Each needle has a double eye, the lower eye is for suturing the needle with silk thread to the neighboring lingual tissue, the upper eye is for external anchorage by means of a heavy thread, which passes out of the mouth. It is important that the buried needles are parallel with each other. Furthermore, the needles must be a distance of one centimetre or more apart from each other in order to prevent possible necrosis from too heavy radiation and from secondary rays flying from adjacent needles.

Ordinarily, about as many platinum tubes of emanation are employed in the treatment of the tongue cancer as there are millicuries destroyed in the total dose, *e.g.*, if the total dose is to be sixteen millicuries destroyed, then sixteen needles having one tube of emanation each are used. Occasionally, when the needles are long, some of them contain two tubes of emanation, in which case correspondingly fewer needles are used. In order to obtain the required dosage these needles must sometimes remain *in situ* for as long as five days. The maximal quantity of desirable irradiation is approximately one hundred millicurie hours per cubic centimetre of tissue. This is sufficient to produce a radium reaction of the tissues, but not enough to induce radio-necrosis.

Some patients who are suffering from very advanced cancers and for whom even a local or partial healing is not to be expected can be helped by radium therapy. In such an instance one cannot safely use the same rules as when a less advanced state of the disease permits an attempt at curative therapy. In the intentionally palliative treatments the therapist abstains from large doses and prefers moderate successive irradiations to a single intense one.

Regaud's principles in the treatment of lingual malignant disease are

1 To distribute numerous and weak radio-active foci in the whole cancerized part and immediately around, having the care to create a radiation field as homogeneous as possible,

2 To use the gamma rays only in order to avoid a necrotizing effect,

3 To give a continuous irradiation for a long time, reducing thus both the intensity and the dose,

4 To expect success from but a single treatment, in order to avoid auto-immunization of the neoplasm against the radiations

The principal causes of failure in this method of radium puncture of the tongue are recited by Regaud as follows

1 A too narrow estimation of the cancerized place,

2 The want of accuracy, especially in the places difficult to reach (*e g*, in the pharyngeal part of the tongue),

3 An insufficient global (total) dose, or too much inequality in dealing out of the dose given out by the different needles,

4 An imperfect material of the needles,

5 Radio-necrotic accidents

According to Regaud, radio-necrosis is caused by

1 The excess of the global (total) dose,

2 The excess of the dose in a limited area, resulting from a few needles being wrongly placed,

3 The repetition of the treatments,

4 A too weak screening,

5 The simultaneous association of radium puncture and of strong irradiation from an external source

(a) *Doiso-lingual Anterior Cancers*—By virtue of their accessible location and anatomy these cancers are easy to treat by the previously mentioned procedures Radium puncture or interstitial irradiation is superior to the surgical extirpation of such cancers The very small ulcerations of the tongue, of which the clinical diagnosis is uncertain and of which biopsy is practically equivalent to the total removal, are left to surgery If the lingual cancer is operable and a previous attempt to cure it by radium therapy has failed, then the tongue should be amputated, because a second treatment by radium is less efficacious than the first, a third one less than the second, and so on When the tongue is covered with multiple leucoplakia tending to undergo malignant degeneration, amputation is preferred to decortication

(b) *Doiso-lingual Posterior Cancers*—These cancers are difficult to treat by interstitial irradiation because of their position, this same handicap obtains for surgery even when the cancers in this location are small Some of these lesions descend very deeply into the pharynx and are poorly treated by radium puncture alone, some of the cancer cells frequently remain viable if not unscathed, hence supplementary external irradiation at a distance should be given over the superior part of the neck

(c) *Cancers of the Infra-lingual Area and Floor of the Mouth*—Even when tiny, cancers of this region are seldom removed successfully by surgical

means In recognition of this the technic at the Radium Institute has been to apply topical or surface irradiation to the superficial carcinomas of the floor of the mouth anteriorly In suitable cases with little infiltration an apparatus in the nature of a wax moulage is moulded directly and applied to the floor of the mouth, during this procedure the tongue is protected by a lead sheet Radium puncture of the floor of the mouth frequently causes radium necrosis, another dangerous complication is the occasional development of phlegmonous inflammation of this area In those infra-lingual cancers where a progressive cancerous infiltration into the deep muscles of the tongue occurs, an intrabuccal moulage would be insufficient, in such an event, interstitial irradiation of the infiltrating tumor must be performed

Interstitial irradiation is carefully avoided when the carcinoma involves the mucous membrane covering the inferior maxilla Such a region is treated by the application of radium on a mould, or, if this is unsuccessful, the maxilla is resected and the site later irradiated by external radium therapy (curietherapy) at a distance

After the direct irradiation of the floor of the mouth has been completed, a wax moulage is adapted to fit under the chin (submental area) The focal distance from radium to skin is 2.5 to 4 centimetres, in inverse ratio to the depth of infiltration of the cancer The filtration is one millimetre of platinum It is important to observe that the submental irradiation is never given until the intra-oral irradiation has been completed The reason is that secondary radiation from the intra-orally disposed platinum capsules and lead protection sheets may induce radio-necrosis The irradiation of the supra-hyoid region through the neck is useful, not only on account of the frequency of lymph-node contamination but also to fulfill a cross-fired irradiation of the internal primary lesion If lymph nodes are already palpable, the irradiation is preceded by surgical extirpation of such lymph nodes

Example of Management of an Infra-Lingual Cancer (Treatment by Doctor O Monod)—A papillary tumor was found on the anterior floor of the mouth at the junction of the tongue and buccal floor Inasmuch as it was not deeply indurated, Doctor Monod made a wax mould to fit in the floor of the mouth under the tongue The focal distance was obtained by the intervention of one centimetre of wax The filtration was 0.5 millimetre of platinum To obtain this, the wax moulage was studded with several tubes of radium element, each of 3.33 milligrams, giving off 25 microcuries destroyed hourly

The area to be treated equals seven square centimetres Dosage, at one millicurie destroyed per square centimetre $7 \times 1 = 7$ millicuries destroyed The radium employed consists of six tubes of 3.33 milligrams strength $6 \times 25 = 150$ microcuries destroyed hourly Irradiation for eight hours daily $8 \times 150 = 1200$ micro- or 1.2 millicuries destroyed daily The total time 7 millicuries destroyed — 1.2 millicuries destroyed = 5 days and 6½ hours

After the intra-oral treatment was completed a wax moulage was made of the submental area The focal skin distance was four centimetres The filtration was one millimetre of platinum The total skin area irradiated was 132 square centimetres The total dosage was 300 millicuries destroyed (40,000 millicurie hours) The dose per square centimetre of surface was 2.19 millicuries destroyed The time of treatment was

for ten days of eight hours daily. The amount of radium employed was fourteen tubes giving 100 microcuries destroyed hourly, and forty-nine tubes giving fifty microcuries destroyed hourly.

Cervical Lymphadenopathies—The frequency and promptitude of invasion of the cervical lymph nodes occur in the following order of ascendancy: dorso-lingual anterior cancers < dorso-lingual posterior cancers < infra-lingual cancers. Cancerous lymphadenopathies follow cancers of the lingual and sublingual areas with greater frequency than obtains for labial cancers. The infiltrating carcinomas are more precocious in their metastases than the papillary types. The lymph nodes involved from cancers of the tongue are not as easily perceived as those from the lip, the former occur deeply and nearly always in the submaxillary region or under the sternocleidomastoid muscle and in contact with the great vessels of the neck. In infra-lingual cancers the submaxillary lymph nodes are usually the first relay. The invasion of the carotidian lymph nodes alone, with the submaxillary nodes remaining free, is very rare in the infra-lingual cancers. It is a frequent finding in cancers of the dorso-lingual anterior area and is even more common accompanying those cancers of the dorso-lingual posterior region.

Very small primary lingual cancers (posterior, especially) are sometimes accompanied by relatively massive cervical lymphadenopathies, indeed the primary lesion may be so small as to escape immediate suspicion or detection by the patient and clinician.

The customary procedures in the management of these cancerous adenopathies at the Radium Institute are as follows. If there are palpable adenopathies in the neck, they are not molested until after the radium reaction in the tongue has sufficiently subsided (a period of about three weeks). Then a unilateral complete block dissection of all the cervical lymphoid tissue is performed, very seldom are both sides subjected to operation. Every lymph gland is examined histologically, if found to contain carcinoma, the neck is irradiated by radium therapy at a distance. If no microscopic evidence of carcinoma is discovered in the excised lymphoid tissue (*i e*, if it be inflammatory only), then the neck is not irradiated, but careful watch is observed.

If there are no palpable lymphadenopathies after irradiation of the tongue, the procedure is sometimes different. If the patient lives in the provinces and cannot be watched closely, the neck dissection may be carried out prophylactically, the excised lymphoid tissue examined microscopically and the neck irradiated, depending on the positive findings. But if the patient is accessible and can be seen frequently the neck is left alone and the policy of watchful waiting pursued. If adenopathic enlargements appear later, they are dealt with as explained above.

Neck Dissections—At the Radium Institute neck dissections are not performed when the general state of the patient is bad, when the lingual cancer is very tiny, when there are no perceptible adenopathies in patients who are under constant surveillance, and when the cervical lymph nodes are voluminous and so fixed as to render surgical removal dangerous to the patient.

The last contraindication is not an absolute one. When the lymphadenopathies are too adherent to be totally and correctly removed (*i.e.*, when the knife cannot pass outside the tumor mass without opening it), Professor Regaud believes it worth while at times to remove surgically the greatest part of the tumor, because its large size is one of the contributory factors in the failure of radium therapy. External curietherapy (radium) always follows the surgical act.

Crile's operative technic with local anæsthesia is followed. If the intra-oral lesion is unilateral, usually the neck dissection need be done only on the side corresponding. When done unilaterally, the sternomastoid muscle and internal jugular vein are practically always removed. If the primary cancer is on the anterior tip of the tongue, or on the anterior floor of the mouth, or on the lower lip in the mid-line, or in the presence of bilateral cancerous adenopathies from any intra-oral source, the radical neck dissection is carried out only on the side of the neck most involved, on the opposite side the lymph nodes only are extirpated.

Irradiation of the Neck—It has been asserted that the secondary or metastatic cancer growth of epidermoid carcinoma in lymph nodes is less radiosensitive than the primary lesion. Regaud agrees that these cancerous nodes are more difficult to cure. But by a comparison of the true sensitivity of these localizations (which is measured by the dose necessary for the sterilization per unit of volume, all the other factors remaining the same), Regaud has explained and demonstrated that there is no appreciable difference between the primary lesion and the secondary growth in the lymph nodes.

After a survey of the percentage of cured patients at the Radium Institute, where the cervical lymph nodes have contained microscopically evident cancer, the authorities agree that post-operative curietherapy has increased the efficiency of the surgical dissection. However, the treatment of cancerous submaxillary and carotidian lymphadenopathies by the application of radium at a distance is not as successful as transpelvic radium therapy for cancer of the uterus, because in the neck there is only one area or "champ" for irradiation of each side.

Doctor Coutard's factors for the X-ray treatment of pharyngeal and posterior lingual cancers with cervical metastases are: kilovolts, 200, anticathode skin distance, 40 to 60 centimetres, filtration, 15 to 20 millimetres of zinc plus (+) 3 millimetres of aluminum, the cutaneous portal of entry, 50 to 150 square centimetres with an occasional supplementary buccal portal of entry. The results are not as good as when interstitial irradiation is used in the primary lesion, because the coefficient of intensity of the X-rays in the neoplasm proper is usually only one-fourth or one-fifth of the epidermicidal dose. Satisfactory results with the X-ray are generally not attained in the depths without destruction of the cutaneous epithelium of the surface (a temporary elective radio-epidermitis). The entire dosage is consummated in less than three weeks. The X-ray alone does not cure adenopathies following epidermoid carcinomas of the cutaneous type of evolution, according to Doctor Regaud.

INTRA-ORAL CANCERS AT THE UNIVERSITY OF PARIS

External radium therapy at a distance (curietherapy) is the method of choice for irradiation of the neck at the Radium Institute. A wax case or moulage is made for each patient's neck. After it has been used it is labelled and stored for possible future use if the patient ever needs retreatment. The wax is the preparation of Drs. O. Monod, A. Esguerra and G. Richard. Its formula of composition is

1 Cire d'abeille pure (pure beeswax)	100 grams
2 Paraffine fusible at 62° C	100 grams
3 Sciure de bois finement tamisee (finely sifted sawdust)	20 grams

The sawdust greatly diminishes the weight of the apparatus. When the mixture cools in sheets one centimetre thick the sawdust layer sinks to the bottom, it is this side which is placed next to the skin, because the waxy part softens too readily. The gamma rays are easily diffused through this material, which has about the same absorption coefficient as the skin. The composite wax can be softened easily in hot water at 48° C. It can be sterilized at 120° C and used again.

From 500 to 750 milligrams of radium, having a filtration of one millimetre of platinum, are placed seven centimetres from the lateral surface of the neck. Distance is obtained by a box-like wax moulage, which is lined with lead plate four millimetres in thickness. The lateral cervical area to be irradiated is marked out rectangularly with an indelible pencil. Then a sheet of wax while soft is moulded to the corresponding neck, shoulder and side of the head. On the external surface of this wax is marked an area corresponding to the one delineated on the skin. The four millimetre lead sheet, twelve centimetres high to prevent lateral radiation, is folded to make a four-sided lead wall, which is trimmed to fit over the marked area on the wax. Now without this lead box, molten wax is moulded to give it support and to fasten it to the wax moulage of the head, neck and shoulder. Within the lead-lined cavity and upon its wax floor are placed upright cork blocks, five centimetres high, and upon these as legs is applied another layer of wax, which fits within the lead rectangle. Over this top layer of wax are distributed the radium tubes. The radium is, therefore, seven centimetres from the skin surface. One side of the neck receives about 500 millicuries destroyed, which is the equivalent of 66,500 millicurie or milligram hours of irradiation. This would mean a surface dose of approximately three and one-half millicuries destroyed for every square centimetre of skin surface. If both sides of the neck (right and left anterolateral) are to be irradiated, the full amount of 500 millicuries destroyed is not used on each side. The box is worn from eight to twelve hours daily, depending on the amount of radium available, and the treatment is extended over ten to twelve days.

External and bilateral curietherapy and rontgenotherapy of the superior part of the neck frequently produces a disagreeable but temporary radio-epithelitis not only of the mouth but also of the pharynx. This causes dysphagia and temporary hypo-alimentation sometimes broncho-pulmonary infection. In irradiating the neck it should be remembered that the mucosa

of the pharynx, larynx and œsophagus are especially predisposed to radio-necrosis. Necrosis of the inferior maxilla is prevented by the extraction of all loose, infected teeth, and the disinfection of the buccal cavity.

Doctor Regaud has not persevered in the practice of transcutaneous radium puncture of the lymph glands of the neck, nor of radium-surgery (*i.e.*, of putting radio-active foci in the lymph nodes after exposure by a surgical incision), because these two technical procedures have not given good enough results. However, the transcutaneous radium-puncture form of interstitial irradiation, accomplished with radium needles is sometimes used in submaxillary and submental nodes, when they are very large and fixed to the deep tissues and to the skin. Radium puncture for carcinomatous cervical adenopathies is dangerous in the carotid region because of the proximity of the large blood vessels. Alone, radium puncture is insufficient, but completed or followed by irradiation from a distance, this type of interstitial radium therapy offers valuable services for these voluminous nodes, easily accessible but inextirpable. Regaud has warned radium therapists that curietherapy by external foci must never be practiced together with radium puncture, because of radio-necrosis which may result from secondary radiation arising from the heavy metal of the needles.

Cancers of the Lip—Lip cancers receive irradiation from three sides by the surface application of a wax moulage in whose superior surface the radium tubes are implanted. The wax is the same as that previously described, it is superior to dental modelling compound, which sometimes gives off secondary radiations. The focal distance is only 0.7 centimetre from the lesion, which distance is obtained by the thickness of the intervening wax. The filter used is 0.5 millimetre of platinum. Radium element is employed. The platinum tubes used to attain the correct dosage are of such a radium content that they each give off either twenty-five or fifteen microcuries destroyed hourly, *e.g.*, the tube containing 3.33 milligrams of radium \approx twenty-five microcuries destroyed hourly. The dosage of irradiation is 0.7 millicurie destroyed (93.1 millicurie hours) for every square centimetre of tissue. This is not given continuously, about eight hours daily for six to seven days are needed to give the total and correct dosage.

Lymphadenopathies from Lip Cancers—In the case of labial cancer where no palpable lymph nodes exist, examinations of the neck are made preferably by the same doctor who treated the lip. The patient is examined every two months during the first six months, then every three months until the end of the second year then two times during the third year. If palpable adenopathies are present, the management is the same as previously described. Post-operative curietherapy is again preferred to rontgenotherapy.

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TREATMENT OF ACUTE POST-OPERATIVE THYROID TOXÆMIA*

BY ARTHUR S McQUILLAN, M D

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It is a fact that since the proper use of iodine in preparing cases for thyroid surgery the incidence and severity of this dreaded toxæmia have lessened. It is also a matter of common occurrence that not a few cases of Graves's disease, for unknown reasons, do not respond to iodine treatment in the usual way by a temporary improvement and subsidence of symptoms¹. It has often been pointed out that the greatest benefit from iodine in these cases, preparatory to surgery, comes after its use for a brief period of ten to fourteen days, that with further use of this drug in moderately large doses the previous symptoms not only return, but may be intensified, that surgery should be undertaken at the end of this brief period, as at this time the benefit from the proper use of iodine is maximum, but temporary. In spite of this latter, cases are constantly coming to thyroid surgery after having had iodine treatment for months and often years. Possibly for these reasons, the incidence of post-operative thyroid toxæmia is still a matter of concern and is entitled to further consideration in the way of treatment.

This toxæmia is generally of two types, one being acute, occurring suddenly and without warning, even during operation and within a twenty-four-to forty-eight-hour period post-operative. It is characterized by a rapid and increasing pulse rate with lessened volume, a moderate rise in temperature, extreme chorea-like mental and physical restlessness, marked pallor, dry tongue, vomiting, diarrhoea and often a peculiar dyspnoea in which the breathing is slow and sighing and there is a complaint of oppression on chest and inability to take a deep and satisfactory breath. Usually the urine shows the presence of acetone. The whole picture often resembles that of insulin shock. Death may occur suddenly at any time during the progress of this group of symptoms. Less often one sees a subacute type in which the pulse rate and temperature rise more gradually and with fluctuation periods over a week or ten days. There may be periods of restlessness, but it is overshadowed by stupor. Nausea and vomiting are common, and pharyngeal paralysis of varying degree is occasionally seen. This subacute type often resembles the picture of uræmia and is more resistant to treatment. There is no sign or symptom which will foretell this toxæmia, and it is well known that the condition may follow surgery in a patient whose pre-operative thyrotoxicosis is mild as well as in one with a severe type.

There is good reason to believe that this post-operative toxæmia is not an exacerbation of the preexisting thyrotoxicosis occurring post-operatively.

* Read before the Surgical Section of the New York Academy of Medicine, January 4, 1929

TREATMENT OF ACUTE POST-OPERATIVE THYROID TOXÆMIA

In the first place the symptom-complex in the acute toxæmia is different from that seen in a pre-operative crisis. It is true that the subacute may resemble in its symptom group that seen in the final and severe stages of a chronic hyperthyroidism, lasting over many years, but in the latter the thyroid gland shows predominant pathology of destruction or exhaustion atrophy rather than hyperplasia which is the feature of Graves². It is difficult to understand how this toxæmia can be due to too much of a normal thyroid secretion, or even to too much of an abnormal thyroid secretion, when it occurs most often following a subtotal thyroidectomy with the remains of but a small amount of thyroid tissue, and the function of this presumably much impaired, temporarily at least, following the necessary trauma of a most careful and gentle operative procedure, and especially when post-mortem examination shows the remaining thyroid tissue with alveoli lacking colloid and instead filled with disintegrating cells and cell detritus, in other words destruction predominant³. As a matter of fact, in my experience unnecessary trauma during operative procedure predisposes to this condition. All points to a possible fact that the patient perishes from a sudden and complete absence of thyroid hormone, rather than too much of it. Very occasionally this toxæmia has been reported following a single or double ligation of the superior thyroid vessels in an extremely thyrotoxic patient. It is apparent that such a condition is hard to explain on a lack of thyroid hormone basis, but with the function of this gland so bound up with that of the involuntary nervous system, it is reasonable to believe that a temporary acute suppression of function could take place which has its analogy in the function of other organs.

The intravenous administration of iodine has gained some repute in the treatment of this condition. The results vary in different cases and with different workers. In my experience it has not usually been of value and surely not as reliable as some other remedies. It is not clear how iodine can be of benefit, if to be of benefit, it must be metabolized into a useful product by thyroid tissue, whose cells are presumably at least temporarily damaged, functionally or even structurally.

It is a common observation that glucose helps this condition. It usually improves the nausea, vomiting, and restlessness⁴. There is much to make one believe that sugar is an important food for the central nervous system which controls the storing up and dissipation of energy, this latter being so closely associated with thyroid function, which in turn has a definite relation to sugar metabolism. Thyroid feeding increases the circulating blood sugar. In hyperthyroidism the circulating blood sugar is increased and thyroid feeding increases it still more. Partial thyroidectomy decreases glycosuria⁵. Hence it would seem that thyroid feeding should make sugar more available for the half starved nervous system in this toxæmia, and especially since evidence points to a lack of thyroid hormone in this condition.

A good preparation should be indicated in this condition. Rogers⁶ and Santee⁷ have reported cases of post-operative thyroid toxæmia strikingly benefited by the subcutaneous and intravenous administration of a liquid

thyroid preparation called Thyroid Residue. This latter is a filtrate containing non-coagulable thyroid substance and is that which remains after the minced pig thyroid gland has been extracted with normal saline, salted out to remove globulins, acidified and boiled to remove the acid albumens, made alkaline and boiled to remove the alkali albumens. This filtrate slightly alkaline and concentrated to contain a definite amount of iodine per cubic centimetre has been called Thyroid Residue, and experimentally is capable of raising the circulating blood sugar and stimulating the vagus group of the autonomic nervous system.⁸ This latter action would tend to slow the pulse rate rather than accelerate it. The benefits described have been a reduced pulse rate and temperature, an amelioration of restlessness, delirium, nausea, and vomiting.

In support of these observations, I can report several cases in which there was much benefit from the subcutaneous administration of this thyroid preparation. In some few cases of my series it has had no effect, but in the majority it has been of much value. This preparation undoubtedly represents only a fraction of the complete thyroid hormone. It should be mentioned that thyroxin is valueless in this toxæmia due to its slowness of action.

In the chart records there is seen an immediate and definite improvement in the rate of pulse and rise of temperature in these cases, but another very suggestive observation is that the effect of a single dose of this thyroid is but temporary, when it is used up so to speak, the previous toxic state recurs and can again be benefited by another dose of thyroid. In these cases it would seem that repeated doses of thyroid, the effect of which is but temporary, are necessary until the remaining thyroid tissue recovers enough to support the patient. Both Rogers' and Santee's cases confirm this latter observation.

NOTE—In connection with this paper there were presented records of nine cases, which illustrated the points made by the author.

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FIBROSARCOMA OF THE THYROID

BY WILLIAM O JOHNSON, M D

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OPINIONS have varied in the past regarding the frequency with which sarcoma of the thyroid occurs, due in part, no doubt, to the difficulty of distinguishing clearly between sarcoma and carcinoma of the thyroid

Ewing¹ states that the occurrence in man of true sarcoma of the thyroid still requires demonstration Ewald² reports that the occurrence of sarcoma of the thyroid is in proportion of one to three with carcinoma of the thyroid, while Crotti³ states that the fibrosarcoma are the most frequently discovered and the least malignant of thyroid tumors, a statement indicating a relative frequency of the disease not in accord with the reports of others Other writers in most instances report spindle cells or mixed spindle- and round-cell sarcoma as most common but only occasional cases of round-cell and fibrosarcoma have been found in the literature

The age incidence, clinical course and gross appearance, together with the modes of metastasis of the sarcomata, are so similar to those of the carcinoma of the thyroid that distinct lines of differentiation between the two do not exist In some cases the differentiation can only be made by the histological picture, but in tumors of the thyroid we know that this method is no absolute criterion

Graham⁴ states that only 30 to 40 per cent of the cases of malignancies of the thyroid can be diagnosed from cell tissue morphology, but when other symptoms and findings are taken into consideration, along with microscopic examination, the diagnosis may be established

Under the above conditions it is easily conceivable, by those who hold the view that the reported sarcoma of the thyroid are only rapidly growing, undifferentiated carcinoma, that, unless the cells are closely studied with special stains, in most instances it is difficult to differentiate sarcoma from carcinoma of the thyroid

In reviewing the literature we are impressed with the looseness with which the early diagnosis of the thyroid sarcoma was made Although tumors of the thyroid have long been known, it was not until 1879 that Alibert⁵ reported a case of sarcoma of the thyroid Following this there were a few scattered cases reported, neither well detailed nor accurate in description, until in 1879 Kaufman⁶ reported a series of malignant thyroidal tumors Muller and Speece⁷, in 1906, present the most inclusive summary of the literature, giving Ehrhardt's⁸ report of 150 cases, together with their collected cases Langhans in 1907 presents an important pathological contribution to the malignancies of the thyroid, a subject which was well summarized by Bauman⁹ in 1920 Wilson,¹⁰ in 1921, published a

report of the thyroid malignancies in the Mayo Clinic from 1901 to 1921. In a very comprehensive way he reviews both the literature and the subject as a whole, presenting photomicrographs, and discussing the characteristic types of malignancies of the thyroid. The above papers have so inclusively presented the subject that a recapitulation here would be superfluous. Eberts and Fitzgerald¹¹ published a paper in 1927, since which time there has been no outstanding report on malignancies of the thyroid. They present an analysis of cases of malignancies of the thyroid gland seen at the Montreal General Hospital, together with a summary of the literature to date. In



FIG. 1.—Case I. Note displacement of larynx to right, and size of growth.

this series of 1876 cases of malignancies of the thyroid cases of sarcoma are included. They state that if sarcoma does exist it is certainly the most deadly of the histological varieties of malignant diseases, and patients rarely survive over four months. According to their observations the sarcoma seems to be less radiosensitive than other forms of malignant neoplasia of thyroid origin.

The highly functioning and greatly predominating epithelial structure of the thyroid gland is such that the natural predominance should be in favor of epithelial growths, and since the thyroid contains in its stroma con-

siderable connective tissue, there is undoubtedly a possibility of the development of sarcoma. De Quervain¹² has stated that all forms of sarcoma do occur in the thyroid and this statement, by such an authority, should be given proper consideration, yet with all the cases reported to date no conclusive facts have been reached, and the question of the existence of sarcoma of the thyroid remains unsettled.

Just as indefinite as is their actual existence is the mode of treatment of these malignant growths. The most practical viewpoint seems to be expressed by Wilson¹⁰, when he writes "Early thorough operations give a fair percentage of cures, palliative operations in late cases with extensive local involvement are warranted." Not only do I agree with this, but in addition I believe that both X-ray and radium should be given to the fullest extent for the area involved, so as to insure every possible chance of recovery, for in some instances the results are most gratifying.

We wish to present two cases of malignant growths of the thyroid which we believe can be classified under the heading of sarcoma, for the charac-

teristics of the growths, together with their history, gross and histological pictures, rapidity of recurrence and end results, justify this diagnosis

Through the courtesy of Dr Wm E Fallis, of Louisville, Ky, I was permitted to see the following case

CASE I—Male, sixty years of age, was first seen June 21, 1928. His chief complaint was swelling of the left side of his neck with hoarseness. He had noticed a small mass on the left side of his neck for eighteen years or more. This has caused him no trouble. He had otherwise been perfectly well. About three months ago this mass in the neck began gradually to enlarge. During this period he has lost twenty-five pounds in weight, accompanied with progressive weakness and nervousness. During the past six weeks the growth has grown more rapidly. Associated with this there has been an increasing hoarseness, shortness of breath, and difficulty in swallowing, so that for the past two weeks he has been unable to swallow solid foods. He had a constant feeling of pressure in his neck, which is worse when head is turned to left, occasional headaches, appetite good, sleep disturbed, occasional nocturia, otherwise negative.

He was a well developed and nourished man, temperature 99°, pulse 80, good character.

There was a marked enlargement on the left side of the neck (Fig 1). Mass about the size of a grapefruit, which pushes the trachea to

the right about one and one-half inches. The skin of the neck is rather hyperæmic, but vessels are not prominent for the size of mass, no bruits or thrills. The mass is firm fairly freely movable laterally or up and down, but seems loosely attached in the region of the trachea. The right carotid is palpable posteriorly to the mass, no definite glands can be made out in the lateral triangles of the neck. The mass seems to be definitely circumscribed and can be felt posteriorly to the trachea on the right side, but does not seem to extend beyond the mid-line of the trachea anteriorly, and extends beneath the clavicle on the left side.

An X-ray film of the chest shows the right lung clear throughout. The left lung shows a substernal mass extending well below the lower margin of the clavicle. No evidence of metastasis made out in field (Fig 2).

Laryngeal examination by Doctor Maupin showed laryngeal œdema and congestion with partial immobilization of cords suggestive of malignancy.

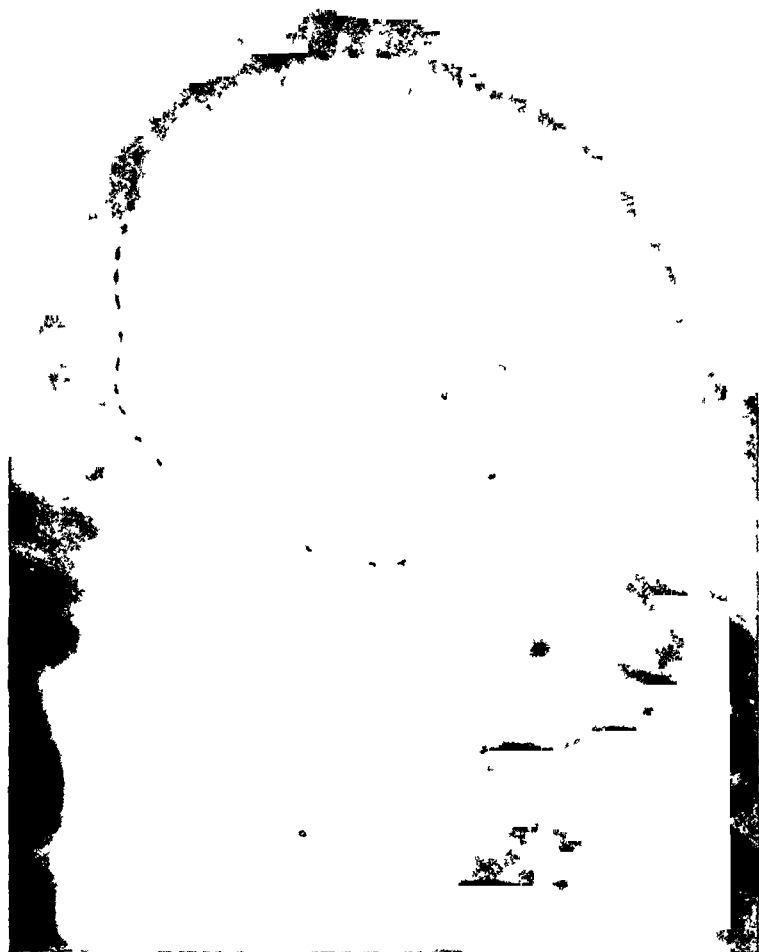


FIG 2—X ray of chest showing size of tumor

June 26, 1928, I excised the growth with the left lobe of the thyroid under novocain local block, wound drained with gauze (Fig 3)

Pathological Report—Specimen consists of four portions of thyroid tissue varying from forty-five to eighty millimetres in their greatest diameters. Largest portion is a dull yellowish-gray, with a rim of dark red, lobulated thyroid tissue measuring fifty by thirty millimetres on one surface. The remainder of the tissue is nodular, fairly firm and has a pale yellowish, mottled cut surface. At pole there is a discrete encapsulated firm nodule measuring fifty-five millimetres in greatest diameter (Fig 4)

Microscopic Description—Sections show a rather cellular tumor made up of rounded,



FIG 3 -Tumor divided longitudinally. Note adenoma in upper pole

oval and polyhedral-shaped cells with fairly abundant cytoplasm and round or oval vesicular nucleus. Stroma is scanty, consisting of blood vessels supported by a delicate reticulum. Section through thyroid tissue shows replacement of thyroid by tumor growth. Cells vary greatly in size ranging from ten to sixty-five microns in their greatest diameters. Cytoplasm stains acidophilic and is fairly homogeneous with distinct fine granules and vacuoles present. Many of the cells have an elongated side suggesting a unipolar arrangement and resemble somewhat a ganglion cell. Nucleus is vesicular and distinct dense staining round nucleolus. In some nuclei the chromatin stains deeply. Only

truly is a mitotic figure found. Few cells are multinucleated. Most of the nuclei are eccentrically located. *Gross and Microscopic Diagnosis*—Fibrosarcoma

The patient was discharged from the hospital July 2, 1928, in satisfactory general condition. Voice improved, able to swallow solid foods. Slight serous drainage from the wound. Patient returned home and gained in weight. Progressed satisfactorily for a period of two weeks, when the growth began to reappear. Growing quite rapidly, with symptoms similar to the condition before operation. August 4 to August 9, 1928, daily deep X-ray treatments were given, except for August 7, 1928, when two were given by Dr. D. Y. Keith, of Louisville, Ky. Technique, fifteen-inch spark gap, total forty minutes with twenty milliamperes using one millimetre copper-aluminum filter with 170 kilo volts. Patient returned home, but did not progress satisfactorily and on August 19, 1928, returned for further operative efforts.

August 21 I excised the recurrent growth from the left side of the neck. One hundred and forty milligrams of radium in four tubes were placed in the tumor bed for ten hours. Filter, one millimetre rubber, one millimetre brass.

The specimen consisted of an oval irregularly-shaped mass of tissue measuring one hundred and thirty by eighty by seventy-five millimetres. It has a smooth, indistinct capsule in some areas and in others the tissue is ragged. A large blood vessel is surrounded by the tumor mass. Cut surface shows a pale yellowish-gray, lustreless tissue which is somewhat homogeneous except for scattered areas of necrosis and focal areas of hemorrhage (Fig 5)

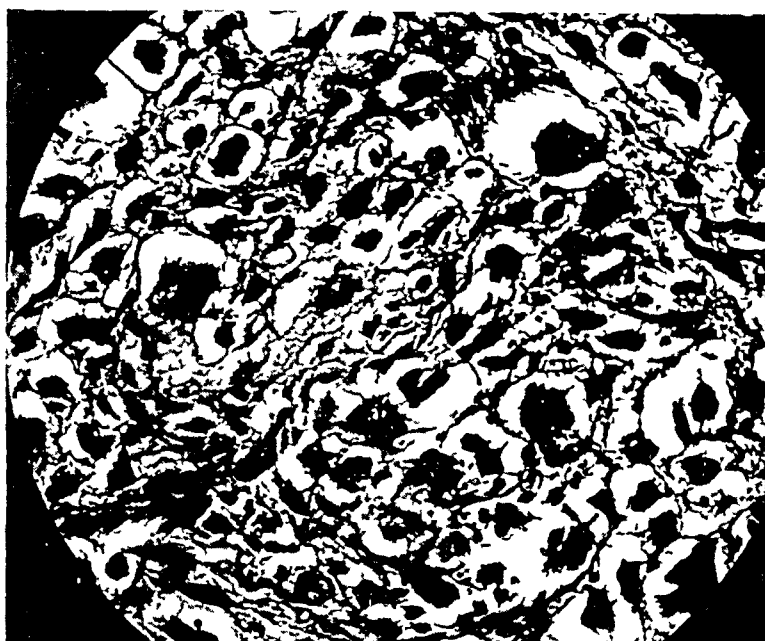


Fig 4—Photomicrograph showing large ovoid cells with scanty stroma Magnified $\times 180$

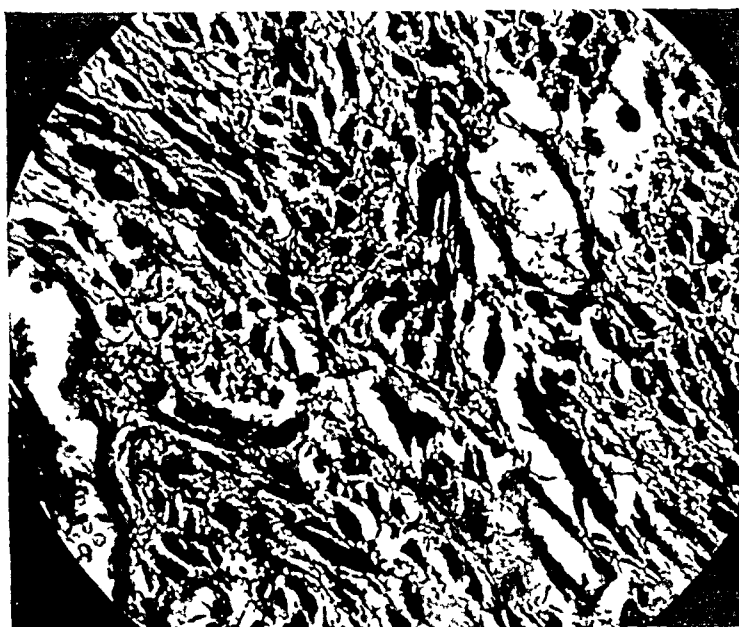


Fig 5—The fusiform shape of the tumor cells is more pronounced in the recurrent growth

Microscopic Description—Sections from different areas show large ovoid cells with abundant cytoplasm lying in a rather scanty stroma. Several areas of necrosis and hæmorrhage are present. The tumor cells have deep-staining, oval nuclei and show an occasional mitotic figure. The cytoplasm of these oval cells are multinucleated. *Note*—The histological picture is similar to the other specimen. *Gross and Microscopic Diagnosis*—Fibrosarcoma.

Patient made a satisfactory recovery, returning home at the end of one week in good general condition, subjective symptoms relieved, small amount of serous drainage from wound. Voice improved, able to eat solid food.

Sept 19, 1928, 1500 milligrams of radium were applied over four surface areas, using one millimetre lead, one millimetre brass and Zo, filter eighteen millimetres from the skin.

After this treatment he apparently progressed well until about one month after the last treatment, when the growth rapidly reappeared. He died December 5, 1928, from possible general metastasis to lungs. Necropsy not obtained.

CASE II—Seen through the courtesy of Dr John R Wathen and Dr D Y Keith, of Louisville, Ky.

Woman, forty-three years of age. Since the age of sixteen, this woman had had an enlargement in the right side of her neck, which was not treated and which had caused no subjective symptoms until August 2, 1928, when associated with a slight cold she noticed that the goitre began to increase in size. In four to five days she had another attack of tenderness in the right side of her neck with more rapid growth of goitre. With tightness of neck, a hacking, spasmodic, unproductive cough, rapidly growing worse developed. The tumor was excised October 6, 1928, by Dr J R Wathen (Figs 6 and 7).

Sections from specimen removed at first operation show a replacement of the thyroid gland by the tumor growth which is made up

of elongated cells typical of fibrosarcoma. The epithelial lining cells of the thyroid acini are the cuboidal type. There is no infolding of the acinar walls. Some of the acini contain colloid. No blood vessel invasion is demonstrable.

Convalescence from this operation was uneventful, neck healed readily, no complications. Two weeks after operation she noticed a feeling of pressure on the right side of her neck which was associated with rapid recurrence of growth, and with this excruciating right-sided occipital headaches, loss of weight (fifteen pounds), progressive weakness, variable appetite, aggravating non-productive cough, shortness of breath on exertion, sleep disturbed by pain in neck and back of head.

Four doses of deep X-ray therapy were administered three weeks after operation. These made her quite sick. The condition rapidly progressed and was so painful that the subjective symptoms could not be relieved by sedatives.

To the right of the mid-line there had developed a fungating type of growth which caused considerable enlargement of the right side of the neck. This growth is quite tender, irregular and nodular, with two or three large lymphatic glands, size of marbles to the right side. Considerable tenderness in post-occipital region. The heart and lungs were clear to percussion and auscultation. X-rays negative. Blood pressure 140/90.



FIG 6—Original specimen. Note adenoma in upper portion of specimen.

FIBROSARCOMA OF THE THYROID

November 23, 1928, palliative excision of recurrent growth of the right side of the neck, under novocain block, and nitrous oxide analgesia, with implantation of nine radium seeds three microns each and one hundred and fifty milligrams radium into wound

Specimen consisted of a mass of tissue measuring ninety millimetres in diameter, with a somewhat smooth, nodular surface on one side and a shaggy, ragged surface on the other. Cut surface shows different appearances throughout the tumor mass. Some areas are pale gray and homogeneous. Others are pale yellowish and striated in appearance with small, dark red, hæmorrhagic areas scattered throughout. A strip of skin measuring ninety by ten millimetres with attached, underlying tumor tissue similar to above (Fig 8)

Microscopic Description—Sections from different areas show a rather cellular tumor growth made up of elongated cells which have rather abundant, clear cytoplasm and oval, deep-staining nucleus. Stroma is scanty, consisting of a delicate reticulum. Blood vessels are fairly numerous. Large areas of necrosis are found. Focal areas of hæmorrhage are scattered throughout. An occasional mitotic figure is found (Fig 9)

Gross and Microscopic Diagnosis—Fibrosarcoma. The woman made a good operative recovery, and returned home Nov 29, 1928, the wound draining a small amount of serum, voice good. Two weeks later examination revealed a small recurrent growth

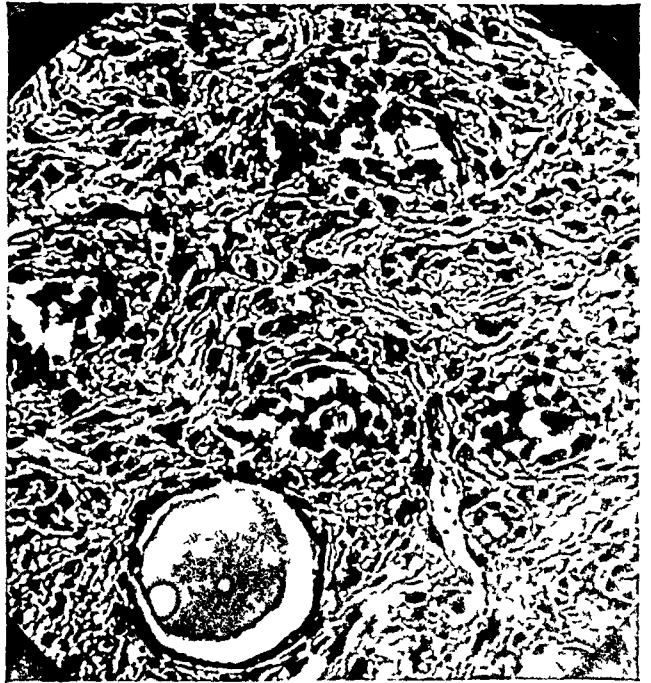


FIG 7—Photomicrograph of original specimen, showing replacement of thyroid. No proliferation of lining cells of acini. Magnified $\times 180$

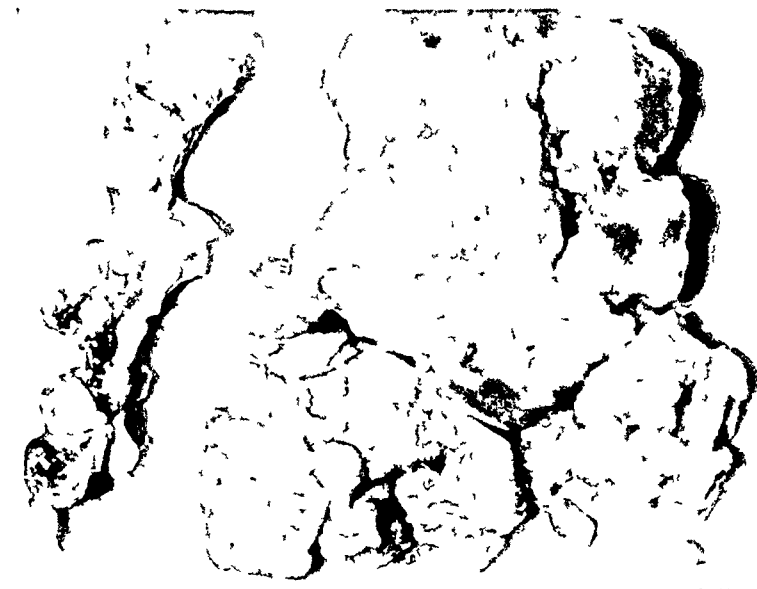


FIG 8—Recurrent growth. Specimen to left removed from behind and lateral to carotid artery

at upper and outer edge of sterno-cleidomastoid muscle. Three platinum covered radium seeds were installed under local anæsthesia into this growth.

January 3, 1929, the wound is granulating slowly, there has been a decrease in the size of the recurrent growth in the upper angle of the neck. The patient is weaker and has some pain in the back of the neck when up. When in bed she is comfortable. One hundred milligrams of radium applied over each of three areas for eight hours. Eighteen millimetres distance, one millimetre brass

and one millimetre lead filter. From the response this patient has made it is evident that the result will be similar to the first case, but since the operation, the patient has been free from pain, rests well, her appetite is good and she has a more optimistic view of life, all of which more than compensate for the procedures taken.

Resumé—These two cases are examples of adenomata of the thyroid pre-existing for over sixteen years which, in later life, become malignant. The solution of this problem would have been so simple had the adenoma been removed in the early thirties, which we now know is advisable with



FIG 9—Photomicrograph showing large ovoid cells with scanty stroma; multinucleated cells are present. Magnified $\times 180$.

all such adenomas of the thyroid. The two cases present three conditions which, I think, are of sufficient importance to warrant their inclusion among the sarcomas, namely, the rapid recurrence of the growth in two weeks after the primary removal, the apparent failure of the tumor to respond to deep X-ray therapy, with only a fair response to radium therapy, and the tendency of these tumors to remain partially encapsulated. The histological picture and the rapid fatal termination of these cases, together with the aforementioned conditions, lead us to classify them as sarcoma of the thyroid.

This diagnosis has been concurred with by five professors of pathology. The type of gross specimen, together with microscopic findings, leads us to the conclusion that they are fibrosarcoma.

These cases are presented, not only because of the apparent rarity of this condition, but in the hope that interest might be aroused to remove these adenoma as a preventive measure and avoid such disastrous developments.

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HOMO-TRANSPLANTATION OF THYROID TISSUE IN CASES OF COMPLETE THYROIDECTOMY FOR CANCER

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THE question of maintaining the function of an organ after radical operations upon it, is a problem of modern surgery. This question was the topic of Rehn's report at the Fiftieth Jubilee Congress of German surgeons.

Lahey, of Boston, has shown how frequently parathyroid bodies are removed even during a subtotal thyroidectomy. He has demonstrated parathyroid bodies entirely surrounded by thyroid tissue in the upper pole of the removed glands. Such a position of parathyroid tissue makes possible its occasional removal during partial thyroidectomy, in which cases the later development of various degrees of tetany occurs. In such cases, Lahey has proposed immediate transplantation of these parathyroids into the belly of the sternomastoid muscle.

Professor Borgoras once attempted to replant the leg in a case of excision of the knee by preserving the vessel-nerve fasciculus. Other operations might unite a necessary radicalism to a simultaneous conservation of the function of an organ. In certain conditions, however, the only way to save a life is to remove an organ entirely. Cancer of the thyroid gland is in this class.

After extirpation of the thyroid, however, there is usually developed a not less serious disease—post-operative myxœdema. In order to replace the lost function of the thyroid, Kocher proposed transplantation of goitre tissue from a case of Graves's disease or the hypertrophic tissue around a nodular goitre.¹ The success following this procedure has given a solid basis to the full removal, in cases of malignancy, of the thyroid gland. Such transplantation of gland tissue is to be preferred to thyroid feeding treatment, a method which is not always sufficient and which condemns a patient the whole of prolonged life to a remedy against which there are cases of permanent idiosyncrasy or gastric intolerance.

The statistical tables of the large clinics of both Europe and the United States show that malignant disease of the thyroid gland is not very rare. On the average, every twenty-sixth operation on the thyroid gland involves a malignant tumor. As to predisposing factors of malignant disease of the thyroid gland, all authorities agree that the presence of a benign goitre often clinically precedes a cancer. A preexisting benign goitre is pointed out in from 80 to 100 per cent. of thyroid gland cancer cases (Pemberton,² Aschoff, Balfour, Grover-Lloyd, Slesinger, etc.). Thus the adenoma must be looked on, to a certain extent, as a precursor of malignancy.

We have succeeded, after microscopical examination of a specimen removed at operation, in getting histological confirmation of the above-mentioned clinical observation that the malignant neoplasm may originate in a preexisting goitre.

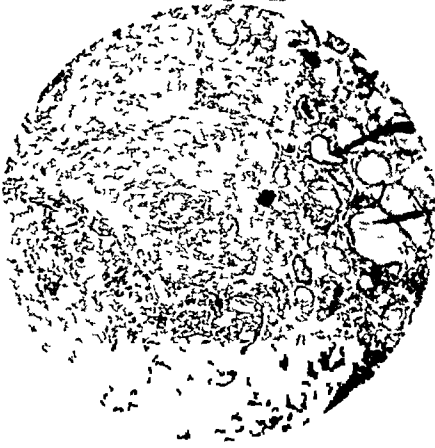


FIG 1—Low power view of peripheral part of removed tumor specimen showing a typical struma colloidis microfolliculosis

The microscopical investigation of the removed tumor showed a different picture in the parts situated at the periphery and those more deeply placed. From the periphery to the centre is to be seen at first a typical picture of microfollicular colloid struma (Fig 1). Among the isles of follicles and single follicles both narrow and broad streaks of fibrous, with here and there hyaline, connective tissue are seen. All the follicles are filled with colloid and are everywhere surrounded by a single layer of cubical, somewhat flattened, epithelial cells. A little deeper, a papilliferous structure of tissue is already to be seen (Fig 2). The base of the papillae is formed by porous and fibrous connective tissue in which vessels of capillary type have been established. These papillae themselves are covered by a single



FIG 2—Photomicrograph of the centre part of the same specimen as in Fig 1, Papillary cyst

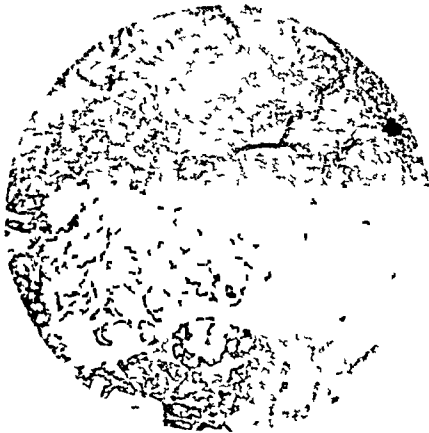


FIG 3—Photomicrograph of a more deeply situated part of the same specimen on Figs 1 and 2. Papilliferous cystocarcinoma

CASE—A woman, thirty-seven years of age, entered the clinic March 24, 1928, on account of a neck tumor producing difficult deglutition and accompanied by general debility. The tumor was first noticed two years previously. She had been treated by galvanization and thyroid feeding, the tumor was growing, except malaria, she had not had any other diseases, no family history of malignancy, internal organs normal excepting moderate enlargement of the spleen, temperature normal, pulse 100, blood pressure 85/115, white blood cells 5600. The tumor consisted of two unequal parts, the smaller one the size of an egg, of very hard consistency, larger one the size of an apple, dimly fluctuating and extending beneath the jaw bone. April 4, 1928, tumor was extirpated, death fifteen days later from hæmorrhagic infarct into lower part of left lung.

row of slightly flattened cylindrical epithelium with basal disposed nuclei. Sometimes the epithelial cells are placed here in many rows immediately after this (Fig 3, left side). The papillae disappear gradually and epithelial cells form here continuous acini-shaped heaps. The acini are covered by several layers of cells and have small cavities. In such places a polymorphism of epithelium is already clearly notable. Finally (Fig 3, right side), we meet a powerful growth of hyaline connective tissue immediately adjacent to the just-mentioned area, which tissue is penetrated by malignant cells much changed in their shape, irregularly spread and characterized by the multiple strata and other evidences of abnormal growth tendency. All these conditions now declare a malignant neoplasm and warrant a diagnosis of cystocarcinoma papilliferum.

HOMO-TRANSPLANTATION OF THYROID TISSUE

Thus in the study of the histological picture of this removed tumor we have found, from its periphery to its centre, three alternating pathological processes—a benign goitre, a papillary cyst and a malignant epithelial tumor. Such a successive change of pathologic processes in the same specimen warrants this as a histologic argument in addition to the clinical observation that cancer has been preceded by a benign goitre. In my opinion, a real danger attends the retention of an adenoma without early operation.

A total extirpation of the affected thyroid gland inevitably causes more or less severe symptoms of hypothyroidism. In such cases of hypothyroidism in our clinic, thyroid homo-transplantation has been used to compensate for the lost function of the thyroid, using for the transplant, usually, goitre pieces from a case of Graves's disease or from the hypertrophied thyroid tissue around a nodular goitre. In the transplantation, not only are pieces of the gland put into the receiver's body, but also an anastomosis is made of one of the thyroid arteries of the transplant to the patient's inferior epigastric artery or common carotid artery. The veins of the transplant are previously ligated in order to form a more abundant filling with blood of the transplanted piece. The circulation of the blood through the divided and anastomosed vessel is, at first, feeble and therefore it is necessary to hinder the efflux of blood by ligating the veins of the transplanted gland. There is no danger of a hæmatoma formation because a moderate amount of blood flowing at first through an anastomosed vessel can be absorbed by the neighboring tissue.

As to the later fate of such a transplant, various authors have been of varying opinions, although there have been many evident clinical facts of success. German authorities, especially Lexer and his school, are of the opinion that the homo-transplantation of endocrine glands is not successful and that this treatment is merely palliative. They affirm that the homo-transplant disappears sooner or later in the receiver's body. Others (Albert Kochei, Voronov, Retterer, Mauclair) assert that the homo-transplanted tissue is active at least for several years. The opinion of both sides is corroborated by many clinical observations and experimental observations, but of course only those cases in which the subsequent condition of the homo-transplant has been verified by autopsy or by exploratory incision during life, a long time after operation, are of value. Such an examination of patients after several years of successful function of the homo-transplantation of thyroid tissue is known in literature at least in two cases. Von Eiselsberg communicates a case in which total thyroidectomy was done by Billroth upon a girl of seventeen years, followed by typical signs of tetany. Twenty-five years later, the patient came to the Eiselsberg clinic where her tetany was treated by transplanting a piece of thyroid gland from a goitre patient into the space between the peritoneum and the fascia. This woman died from mental disease several years after the transplantation. A post-mortem examination showed that the transplantation had left no marks at the place of its transplantation, while an hypertrophic goitre the size of a hen's egg was found in the lower portion of the liver. In the second case (Stieda) death occurred from

tuberculosis in three and one-quarter years after transplantation when all symptoms of myxœdema had disappeared without leaving any traces. At the necropsy no marks of the transplanted thyroid tissue were found, but the receiver's own gland was observed to be small and atrophic.

In addition to these valuable observations, we can produce a similar case

A woman, fifty-six years of age, was admitted to the Borgoras Surgical Clinic Janu-

ary 27, 1928, eight months after an operation of total thyroidectomy for cancer by Doctor Gutnikov. During this time, the patient had developed characteristic symptoms of severe myxœdema. The first signs of hypothyroidism had appeared six weeks after a total thyroidectomy. The patient was then treated by thyroid feeding, but even small doses of thyroid preparations caused her grave attacks of cardiac palpitation, collapse included, also stomach trouble. This was a phenomenon of a permanent idiosyncrasy to different products of thyroid gland tissue. On her admission, the important findings were dryness of skin and hair, constipation, œdema of face and tongue and also intense somnolence (Fig 4), pulse 60, temperature subnormal, kidney secretion defective. Eight weeks after admission a homo-trans-



FIG 4 —Before operation

plantation was done by Professor Borgoras. The transplant was taken from a compatible blood patient whose goitre had to be removed. The transplantation was accompanied by an anastomosis of the superior thyroid artery of the transplant to the patient's inferior epigastric artery. A fortnight after the operation, all her symptoms of myxœdema had disappeared. She was discharged in perfect health without any symptoms. Fig 5 shows her on discharge from the hospital. After she had been quite well for six months a metastasis of cancer of the liver was suspected and a course of Rontgen treatments was applied. Within a few weeks all her symptoms of myxœdema came back. She returned to the clinic where, seven months after the first transplantation, a second one was done. This operation was done at the site of the original one in order to examine the condition of the thyroid tissue transplanted seven months previously. Macroscopically, there could be detected no marks of the thyroid isograft. Several bits of surrounding tissue were removed for microscopical examination which investigation made by Doctor Zazybin did not reveal any traces of transplanted thyroid gland, but showed only scar, muscular tissue and fat.



FIG 5 —After operation

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PRIMARY HYPERNEPHROMA OF THE LIVER

(GRAWITZ TUMOR)

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HYPERNEPHROMA is essentially a tumor derived from cells embryologically from the same origin as the cells of the adrenal cortex.

Adrenal rests have been demonstrated in numerous tissues which have their origin close to the developmental areas of the adrenal glands. As growth takes place these cells are carried with the developing organ or tissues to locations sometimes quite distant from their site of origin.

Broman¹ has tabulated the areas where adrenal cell nests have been found as follows: Male: Rete testis and epididymis, paradidymis, spermatic cord. Female: Ovary, tubes. Both Sexes: Retroperitoneal tissue beneath the kidney poles, along the spermatic and ovarian veins, ilio-psoas muscle at the pelvic brim, at the iliosacral synchondrosis, in the kidney capsule or substance, on neighboring vessel walls, in the solar and sympathetic plexus, between the transverse colon and the spleen, beneath the capsule of the right lobe of the liver, in the pancreas.



FIG. 1.—Photograph of the bisected gross specimen showing the variegated structure of the tumor.

Quite a voluminous literature on this subject has appeared since Grawitz expressed his belief in the origin of these tumors from misplaced adrenal cells, and although this origin seems most definite there are some writers who are inclined to different views and who advance other theories, some claiming that these tumors develop from such tissues as the endothelium of lymphatics or blood vessels, while others think that the growth is an adenoma or, if malignant a carcinoma. Other writers have found characteristics in their cases which led them to classify these growths as sarcomata or angiosarcoma.

Bothe,² in an excellent article upon the subject of hypernephromata reviews the literature and gives the opinion of many writers on this subject. He tabulates the following theories as to their genesis:

(1) That they originate from adrenal cell rests, (2) that they are alveolar sarcomata having nothing to do with cell rests, (3) that they are endotheliomata which take their origin from the endothelial lining of the perivascular lymph spaces, (4) that they are adenomata if benign, carcinomata if malignant, (5) that they develop from the endothelial cells lining the blood-vascular spaces, (6) that they are derived from the epithelial lining

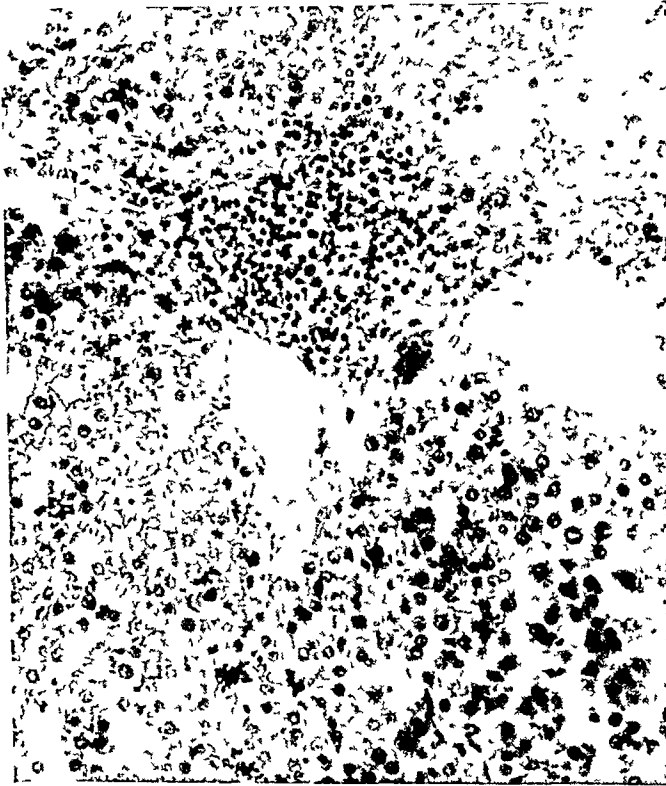


FIG 2—Areas showing pseudo fascicular arrangement of the cells, two blood spaces and an accumulation of lymphocytes in the fibrous stroma Magnification 125 diameters

of the uriniferous tubules, (7) that they originate from islands of embryonic nephrogenic tissue

Bothe also reviews the modern conception of the embryological development of the adrenal glands and kidneys and adds some original observations of the physical relationship existing between these anlagen cells. He concludes that the embryological inclusion of suprarenal cells within the metanephric anlagen is not improbable and that the tissues other than the metanephros are susceptible to such inclusion, especially those which are developed from the mesonephros, mesonephric

duct and genital ridge. In general, he states that from embryological, chemical and pathological observations hypernephromata are quite in accord with the views originally presented by Grawitz.

Primary hypernephromata reported as occurring in organs other than the adrenals or kidneys may be tabulated as follows

- 1 In the broad ligament, 3 Weiss, Peck, Glynn
- 2 In the ovary, 4 Gibben, Peham, Scudder, Glynn
- 3 In the uterus, 1 Eastman
- 4 In the pelvis, 1 Chiari
- 5 In retroperitoneal tissue, 1 Glynn
- 6 In the pancreas, 1 Glynn
- 7 In the spermatic cord, 2 Chevassi, DeBarnardi
- 8 Falciform ligament, 1 Starr
- 9 In the liver, 4 Adams and McCrae, Rollston, Schmorl, Vecchi and Noyes
- 10 In the tongue, 1 Coenus
- 11 In the ciliary body, 1 Schlupp

PRIMARY HYPERNEPHROMA OF THE LIVER

The development of the adrenal anlagen in close embryological relationship with those of the kidneys, ovaries, testicles and epididymis, the uterus and the liver with their contiguous structures and vessels, readily explains the frequent finding of adrenal cell rests in these tissues, and if Cohnheim's hypothesis is at all to be considered it is not difficult to understand the development of tumors, both benign and malignant, from such inclusions. The character of the growth is determined by the stage of development of the anlagen cells at the time they become separated from the main cell mass, and also by the tissues in which they become included.

Case reports of primary growths of this nature in other than embryologically contiguous developing structures are more difficult to explain, but rather than assume that these are metastatic growths and that the original tumor not found, it is just as possible to believe that such embryological formations are possible and are not necessarily cells separated

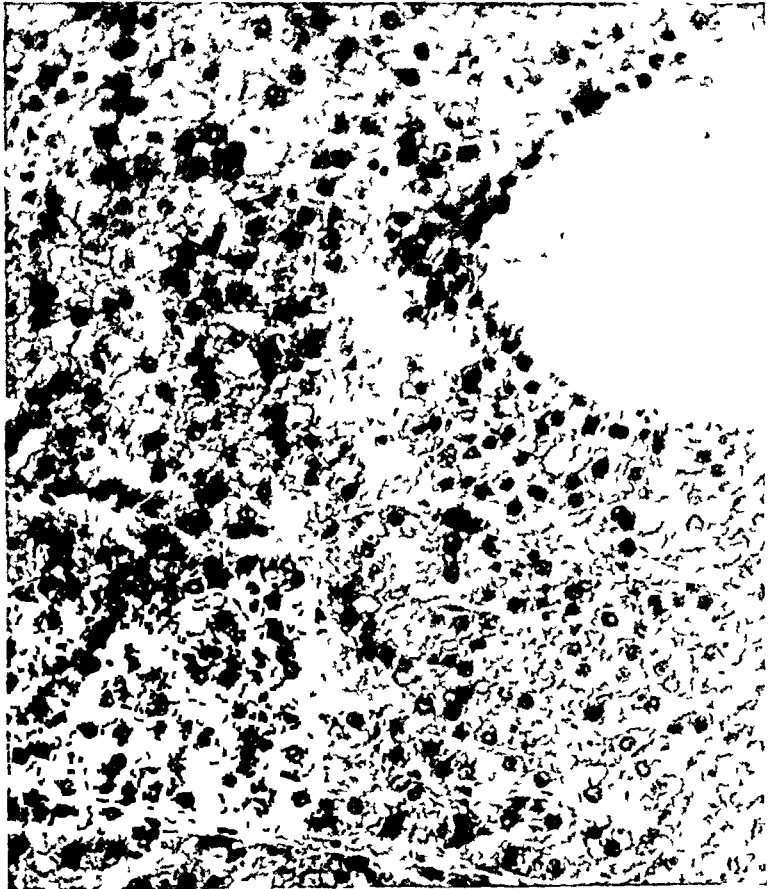


FIG. 3.—Compact area with no definite cellular arrangement. The blood space appears to be lined by the neoplastic cells. Magnification 125 diameters.

from the developing adrenal organ. According to Bothe's views cases of primary hypernephroma of the liver can thus be easily explained as this organ is often the site of adrenal cell inclusions.

Many observers have reported finding these rests in this organ. Schmorl³ found them in four out of 510 autopsies. Beer⁴ reported six positive findings in 150 livers examined. Five were in or just beneath the capsule, one was in the liver parenchyma close to the cortex. In all, the inclusions were in the right lobe. Bothe² mentions four such primary growths in his table. Abell⁵ in reviewing the literature on this subject collected ten cases reported as primary hypernephroma of the liver. Seven of these were in the right lobe, one in the left lobe (Pepere), which Ewing⁶ believes was an hepatic adenoma, and two were in the folds of the falciform ligament. Abell also adds a case report of a similar tumor, observed by him, occurring in a young female child, thirteen months of age. The growth was encapsulated and was attached along the right anterior border of the liver. The

kidneys, spleen and other abdominal organs were normal. The adrenals showed no pathology.

REPORT OF AN ADDITIONAL CASE

The patient was an adult male, fifty-seven years of age. The onset began about one year previous to his admission to the hospital, with vomiting immediately after partaking of any heavy meal. There was no nausea or pain, no blood in the regurgitated material, nor was there any blood in the stool. The patient had never been jaundiced. During the last year he had lost thirty-three pounds in weight.

This patient had had the usual childhood diseases, but previous to the onset of this last illness he had always been fairly well. He had sustained an injury in 1892 at which time he had a fracture of the skull and of the bones of both lower extremities. There was no history of malignancy in his family.

Physical Examination—The patient was an elderly white male of about fifty-seven years. The teeth and gums were in poor condition. The neck and throat showed no apparent pathology. The chest was symmetrical, the lungs were normal, the heart was not enlarged and there were no murmurs. The abdomen presented a large, firm mass in the upper right quadrant extending into the lower quadrant. The mass was movable but was apparently attached to the liver and located just beneath the anterior abdominal wall. The extremities were normal. Neurological findings were normal.

Hospital History—On the day following his admission to the hospital the abdomen was opened. A tumor was found arising from the under surface of the right lobe of the liver. The growth seemed well encapsulated. No other abnormalities or growths were found in the abdomen and no other nodules were found in the liver. The growth was removed and the liver repaired. No great amount of bleeding attended the operation and after packing around the liver border with iodoform gauze and rubber tissue the wound was closed in layers in the usual manner, leaving in the gauze and rubber drain. The patient was given 2000 cubic centimetres of saline solution later, followed by glucose and soda bicarbonate solution. The pulse rose steadily from 100 at 11 A.M. immediately following the operation, to 126 at 3 P.M., became weak and irregular and over 150 by 5 P.M. The patient died the same day at 8:40 P.M. There was no elevation of the temperature and death was most probably due to hæmorrhage from the liver. No autopsy was permitted.

Pathological Report—The growth was ovoid in shape, measuring about twenty-two



FIG. 4.—Area showing blood sinus lined with flattened endothelium. The tumor cells can be seen invading the fibrous tissue of the wall. Magnification 200 diameters.

PRIMARY HYPERNEPHROMA OF THE LIVER

centimetres in length by about fifteen centimetres in diameter, the lower surface was very ragged in appearance where fragments of liver tissue were adherent to a fairly definite connective-tissue capsule. The external surface was inclosed in a thickened fibrous wall which was continuous with the capsule of the liver. The growth was of a yellowish-brown color, and upon bisecting the tumor the capsule was readily visible as described above. The cut surface (Fig 1) presented a variegated appearance as to color and consistency, areas of reddish-brown to black and others yellow to orange and red. Some parts were firm, others soft and spongy. The growth presented a honey-combed appearance with small cystic spaces filled with blood. Several sections were taken for microscopic examination.

Microscopic Findings—

The various areas presented rather a variety of findings. The sections (Figs 2, 3, 4 and 5) varied from dense, compact cell masses, where the cells were well stained and having the appearance of mature adrenal cortical cells arranged in irregular fascicular manner with only a slight degree of lipoidosis and with clear staining nuclei, to areas of less compact structure with large, pale, swollen cells filled with lipoid granules and having rather pale nuclei. In these softer areas considerable destruction of the structure caused the sections to have rather an amorphous appearance showing only invading wandering cells, red cell collections and blood spaces.

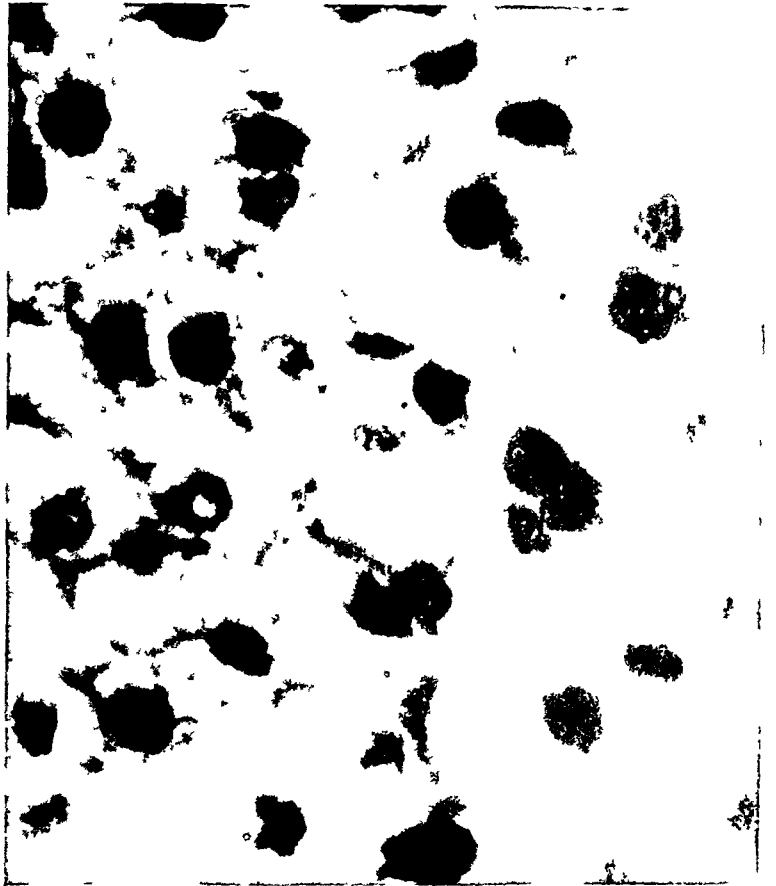


FIG 5—Showing the intercellular fibrillar connective tissue network, the faintly granular protoplasm and the large hyperchromatic nuclei. Magnification 500 diameters.

The cystic areas were filled with blood or blood clot in various stages of organization. Areas of productive inflammation and fibrosis gave the growth a scar-like contracted appearance here and there throughout the tumor mass. Fine filamentous fibrous tissue strands formed a supporting framework showing many blood vessels and extended into the capsule which was well formed and fibrous in appearance.

The greater part of the cellular structure showed variation from mature cell elements to cells of embryonic type, many showing multiple nuclei and others irregular mitosis.

The picture presented corresponds in its entirety to that of malignant hypernephroma elsewhere. No liver substance or biliary ducts were seen in any portion of the growth.

*Comment—*Tumors having the characteristic appearance of hypernephromata occurring as primary growths in various parts of the body most assuredly support the conclusion that these tumors develop from embryological inclusion of suprarenal cells within these various organs at the time of their close proximity to the developing suprarenal organ. Most of these growths as does the one herewith reported, present in some areas the typical appear-

ance of early developing adrenal cells. Considerable variation in cell structure takes place as the tumor develops and even progresses into malignancy. All of these growths may be considered malignant from a standpoint of the production of metastases in other locations, however, the term malignant hypernephroma is used only to include that group which shows malignant characteristics in the cells comprising the growth.

SUMMARY

A case of malignant primary hypernephroma of the liver is reported, having developed in a man fifty-seven years of age. The growth was in the right lobe well encapsulated and removed by surgery.

Microphotographs of different areas of the tumor are presented, showing variations in the cellular structure.

A brief review of the literature is given and comment is made upon the place of this tumor in pathology.

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THE SPREAD OF BACTERIA FROM THE GALL-BLADDER TO THE LIVER *

By WALTON MARTIN, M D

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IN VIEW of the interest taken in the relation of hepatitis to cholecystitis during the last ten years, I take this occasion to call attention to reports of bacterial examinations made from small pieces of the liver excised at operations in which the gall-bladder was removed for cholecystitis and cholelithiasis. The patients, twenty-seven in number, had well-established lesions. No instances of lipoid (strawberry) gall-bladder or instances in which there were very slight inflammatory changes in the wall of the gall-bladder, without stones, were included. The cases chosen belonged in a group in which the disease was confined to the gall-bladder. That is to say, no cases were included in which there was evidence of obstruction or infection of the common duct. In six of the patients there was a history of transitory jaundice in the past, but in no instance before operation had a diagnosis been suggested of common-duct stone or a stone found in the common duct at operation. The common duct was soft and not thickened when inspected.

I have attempted to study a group in which the gall-bladder lesion was well established and to determine how often we could find bacteria in the adjacent liver tissue when examined within a few days of an acute attack.

A small, wedge-shaped piece was taken from the liver margin within five centimetres of the gall-bladder bed. The dimensions of the piece were about $1 \times 1\frac{1}{2} \times \frac{3}{4}$ centimetre. The piece of liver was dropped immediately into a sterilized test-tube in which was a second, small test-tube half filled with sterilized water. The tube was taken immediately to the bacteriological laboratory, Doctor Famulener, the director of the laboratory, or his assistant, Miss G. P. Pierson, carried out the bacteriological studies.

It seemed to me that liver tissue undergoing changes set up by autolytic enzymes might serve as a satisfactory culture medium, well adapted for organisms lodged there, that the technic was simple and would avoid contamination. The inner tube containing water was placed there to prevent the drying of the small section. At first, sealed, moistened tubes were used. The method with an inner tube, devised by Doctor Famulener, proved more satisfactory. For comparison a second fragment was taken, or a portion of the first fragment, and dropped at the same time into a tube containing Rose-now's medium. After twenty-four hours' incubation smears were made and cultures taken, aerobic and anaerobic, upon blood agar and Huntton's medium.

* Read at the joint meeting of the New York Surgical Society and the Philadelphia Academy of Surgery, February 13, 1929.

and dextin broth. These examinations were repeated at the end of forty-eight and seventy-two hours and in several instances, after five days.

The gall-bladder wall was sent to the laboratory for histological examination. The mass of liver tissue we felt justified in removing was too small to furnish material both for bacteriological and histological study, but we assumed that many of the sections of the liver would have shown the changes, classed under the heading hepatitis which have so frequently been found in the neighborhood of an inflamed gall-bladder.

The details of these examinations will be given at the end of the paper. I purpose here to call attention to the number of negative findings, to discuss the different ways that microorganisms may reach the liver and the types of microorganisms when the findings were positive.

It is interesting in studying the zone of inflammation about any focus of infection, to consider how much the area examined represents the defense reaction, walling in the infecting microorganisms, and how much it represents evidence of irritation from bacteria spreading out into the tissue of the zone under consideration, usually in the direction of the lymph flow. For example it is well known that streptococci are found in the lymphatics in advance of the red area in erysipelas, whereas it is also well known that the concentration of microorganisms in the walls of an abscess decreases gradually until at the margin there may be a cellular exudate and œdema with no microorganisms.

In 77 per cent it was not possible to cultivate bacteria from the liver tissue. Such findings might be expected from the reports of the results of bacterial examinations of the bile in the gall-bladder, the gall-bladder wall and the bile of the common duct. These examinations have been made from time to time by different observers in different countries and with different technic after cholecystectomy for cholecystitis and cholelithiasis. In general one may say that, except for the reports of A. L. Wilkie¹ on the findings in the lymph gland near the cystic duct, to which I will refer later, the number of negative findings has been a conspicuous feature. Judd² writes "We have made on a number of occasions bacterial examinations of the bile and the gall-bladder wall. The bile has only been positive in 7 per cent and in none of the groups examined was the gall-bladder wall positive in as many as 50 per cent." In Wilkie's¹ series of fifty examinations the bile was positive in 12 per cent and the submucosa showed cocci in twenty-one out of fifty. Wagner³ in 465 cases in which the bile from the common duct and the gall-bladder was examined, reported 55 per cent negative. The cases reported were all of advanced disease and in forty-nine it was considered necessary to drain the hepatic duct.

These negative findings may be interpreted as evidence that bacteria have a tendency to die out, not only in the bile but also in the gall-bladder wall. The violent disturbance shown clinically by a pronounced attack of pain and accompanying symptoms and shown histologically by a pronounced exudation into the tissue may represent the reaction of the body and its tissues in destroying the bacteria, few in number and of no considerable virulence and

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in overcoming mechanical obstruction. Even in empyema of the gall-bladder Wagner³ found the purulent contents sterile in thirteen out of fifty cases and sterile in twenty-four out of twenty-nine instances of hydrops.

In six instances in our series, bacteria were found in the fragment of liver tissue examined (Table A, Cases I, II, VI, XIII, XVI, XX). In three out of the six, the bacteria were few in number and were difficult or impossible to grow, as if of low vitality or dead, in two Gram-positive micrococci, probably enterococci, were obtained from smears of the autolyzed liver, but they could not be obtained on culture, in a third a few Gram-negative bacilli, probably *Bacillus coli communis*, were obtained in direct smear of the forty-eight hours' autolyzed liver tissue, it was impossible to recover them for growth and identification on any of the media tried, aerobically or anaerobically. There was no growth on Rosenow's medium from a portion of the same fragment. In one of the six, the organism belonged in a group of which the pathogenic significance is uncertain, a Gram-positive diphtheroid organism was identified on the fifth day in the autolyzing liver tissue, which could be recovered by cultures on the usual media. Of the remaining two, in one no organisms were found in specimens of the autolyzing liver tissue but a fragment dropped at the same time into Rosenow's medium showed staphylococci. In the other, a Gram-negative bacillus of the colon group was identified.

In reviewing these findings it is well to bear in mind that bacteria found in the liver in the zone adjoining the gall-bladder, or inflammation of the liver tissue in this zone (hepatitis), by no means justify the conclusion that the bacteria have passed from the gall-bladder or that the cellular reaction has spread from an inflamed gall-bladder.

In the ordinary domestic animals bacteria are found in the organs in a very large number of instances. Ford,¹ using the cat, the dog, the guinea pig and the rabbit, found bacteria in the liver in at least 70 per cent. Each species and each animal showed its peculiar bacteriology. The microorganisms were slow to grow. He writes that "Either the bacteria are present in small numbers in the organs at the moment of death, and only develop gradually after the organs are excised, or the normal bactericidal or inhibitory substances of the organs, originally powerful enough to prevent the growth of the bacteria, are gradually decomposed after the connections between the organs and the animal body are broken, thus permitting a slow development on the part of the microorganisms." Desoubry and Porcher,⁵ by numerous experiments, established the fact that during digestion bacteria of all kinds may pass through the normal mucous membrane of the intestine and may be found during several hours in the chyle and blood. It is probable that these bacteria are arrested and destroyed in the liver. Last year Berg and Jobling⁶ reported in the *Proceedings of Experimental Biology and Medicine* the presence of living anaerobic bacteria in the liver of the dog.

It is probable that in man bacteria reach the liver in the same way from time to time and are arrested and destroyed there and that at times this

destruction is accompanied by signs of reaction which we call hepatitis. The presence of bacteria in the liver or the hepatitis coincident with cholecystitis does not, by any manner of means, imply a sequence in the happenings. Moreover, not only are microorganisms arrested in the liver, but certain of them pass out with the bile. For example, the presence of streptococci was detected by Mathes and Schultz⁷ in a dog with a biliary fistula, fifteen minutes after intravenous injection. I know of no studies of bacteria in the lymph flowing from the liver after massive intravenous inoculation.

A curious condition has been noticed by Counseller and McIndoe,⁸ in studying corrosion specimens of bile ducts both intrahepatic and extrahepatic. They studied the normal liver and livers in which there were various grades of cholecystitis and cholelithiasis. I wish to call attention to their findings in eight instances in which clinical investigation had not shown any evidence of previous biliary disease, and in which the presence of stones in the gall-bladder and their absence in the common duct were revealed only at autopsy. In seven, evident dilatation of the ducts had taken place, mild in character but present throughout the whole system. In the study of ten normal livers the diameter of the common duct was found to be about five millimetres, and that of the right hepatic duct to vary from 1.6 to 3.4 millimetres. In the six cases of cholelithiasis the common duct varied from 6.5 to 11.5 millimetres, and the right hepatic duct from three to eight millimetres. Possibly even slight loss of resilience in the gall-bladder wall caused a certain amount of back pressure in the biliary ducts. The amount of dilatation of the ducts seemed to run parallel and in direct proportion to the amount of the pathological change in the gall-bladder wall. In the one instance in which no change was found in the duct system, although there were three small stones in the gall-bladder, the wall itself was apparently in good condition. Such transitory back pressure, enough to cause dilatation of the ducts, might carry bacteria that were passing out with the bile back into the small ducts and prolong the contact of microorganisms, liver cells and stasis bile. But that such prolonged contact can be of serious moment seems unlikely, since even more pronounced dilatation of the duct system has been shown to follow the removal of the gall-bladder. Paradoxically, it has even been suggested that slight degrees of hepatitis are improved by cholecystectomy.

If there is no damage to the endothelial lining of the common duct by a foreign body, as in obstruction from outside the duct, it has long been recognized that the dilatation of the gall-bladder and ducts is unaccompanied by signs of infection. Under these conditions the bacteria, if they chance to be present, seem not to be virulent enough to gain foothold.

The following observation on obstruction due to a neoplasm seems to me pertinent. The patient had had painless jaundice for several weeks, the bile index was 133. Due to slight fluctuations in the jaundice, it was decided to operate to confirm or refute the diagnosis of carcinoma. The usual picture of obstruction due to neoplasm was found at operation: a thin-walled, distended gall-bladder, an enlarged, thin-walled common duct, an enlarged, dark

liver and a mass in the head of the pancreas. Cultures were made from a specimen of bile removed by puncture. The bile was cloudy, slightly thick, light apple-green in color. The cultures were made on Rosenow's medium and blood agar slant. After forty-eight hours' incubation on both media, smears showed small colon-like Gram-negative bacilli which took an uneven stain. The microorganisms could not be recovered by growth on any of the media tried. They evidently had poor vitality and were dying out in the bile. Microorganisms were present but they had no invasive capacity. (Table B.)

In contrast to this I report the following observation. A negro woman, very ill with chills and intermittent temperature and jaundiced, was operated on, the gall-bladder excised, and a few stones removed from the common duct. Cultures made from a fragment of the liver showed numerous Gram-positive, oval diplococci and Gram-negative coccoid to bacillary forms. (Table C.)

If the same type of microorganisms is found in the bile, the gall-bladder wall and the adjoining liver tissue, it seems fair to assume that the bacteria may have passed from the gall-bladder wall to the liver tissue. In two of the instances in which the liver tissue was positive for bacteria, these conditions were fulfilled, that is, the contents of the gall-bladder or the gall-bladder wall showed the same type of microorganisms and, in one instance, the same combination of types.

In the six instances with positive findings, staphylococcus was found once, bacillus coli communis twice, enterococcus twice and a diphtheroid organism once. The enterococci occurred as short-chained diploid Gram-positive cocci. These findings are in accord with those reported in the past in the gall-bladder wall and in the bile, except that we have not chanced, in this small series, on the typhus bacillus and we have recorded enterococci instead of streptococci.

In a series of fifty recently reported by Wilkie¹ the coli communis was found three times in the gall-bladder wall and the streptococcus was reported in the submucosa of the gall-bladder wall twenty-one times. He reports in forty-three out of fifty, that is, in 86 per cent pure cultures of streptococci in the cystic gland.

The lymph drainage of the gall-bladder is probably largely downward toward the glands at the hilus, not inward, toward the liver. The course of the lymphatics of the liver and gall-bladder is still imperfectly understood. The diagrams and studies of Sudler⁹ are largely concerned with the lymphatics of the gall-bladder wall, not of the liver. The diagrams of the vessels carrying the lymph in most of the textbooks are based on the studies of specimens made many years ago by Sappey, by the injection of mercury. Recently, a Japanese observer, Y. Semba,¹⁰ using Gerota's stain has followed the course of the lymph flow. His illustrations are much the same as those in Sappey. His description is brief and is devoted largely to the course of the lymph from the liver to the thoracic duct. In Sappey's pictures, in Sudler's and in Semba's, the illustrations show the lymph vessels passing over the abdominal or peritoneal surface of the gall-bladder to the ganglia near the cystic duct. The minute lymph vessels passing from the adjoining surface of

the liver become larger vessels as they pass over the gall-bladder wall, as if they received tributaries. If the opposite, or hepatic, side of the gall-bladder has a similar arrangement of lymphatics, then the main lymph flow from the gall-bladder is downward toward the cystic gland, not backward, into the liver. This is in accord with Wilkie's finding.

The streptococci reported by Wilkie as present in the cystic gland are described as diploid forms in short chains. They were not bile resistant and fermented mannite.

The finding of enterococci in our series is of interest. Doctor Famuleneri has, for a number of years, given especial attention to this strain of cocci found in the intestinal flora. In three of the instances reported, as the micrococci could not be cultivated, their identification is uncertain, though morphologically they suggested to him enterococci.

Kurt Meyer,¹¹ Director of the Bacteriological Division in the Virchow Hospital of Berlin, who has also given particular attention to this strain, in a recent article makes the following statement: "The streptococci said to be found in the gall-bladder wall are probably enterococci." In association with Lowenberg he has experimented with rabbits, by injecting intravenously hemolytic streptococcus, streptococcus viridans and enterococcus. The animals were killed in four to twenty-eight days. The gall-bladder was found sterile after the injection of viridans and hemolytic streptococci, whereas, after the enterococcus injections, the microorganisms were regularly found in the gall-bladder. The work of Meyer and his conclusions are reviewed and brought forward in the monograph recently published on the "Normal Intestinal Bacteria and Their Significance for the Organisms" by Nissle,¹² in Wassermann's *Handbook of Microorganisms* (1928).

I wish to call attention

- 1 To the large number of negative findings in the bile, the gall-bladder and the adjacent liver tissue, even in well-marked cholecystitis with cholelithiasis.

- 2 To the finding of bacteria in the liver tissue which stain imperfectly and cannot be recultivated.

- 3 To the prevalence of types in the liver and gall-bladder that grow normally in the intestinal tract.

- 4 To the fact that the anatomical evidence suggests that the lymph flow from the gall-bladder wall is downward toward the glands at the hilus, not backward toward the liver.

- 5 To the suggestion that hepatitis present with cholecystitis may be a coincident, not a consequent condition.

It is interesting to consider these statements in relation to common clinical experience. It is very unusual to have a fatal spreading peritonitis following operations of the gall-bladder and common duct, although these operations are frequently accompanied by gross contamination of the peritoneum with bile and gall-bladder contents especially in opening and draining the common duct. Between attacks patients are frequently fresh colored, well nourished and vigorous, without clinical signs of infection, although when finally

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operated on the lesion of the gall-bladder gives every evidence of long standing

Even in instances where the history dates back for years after the gall-bladder is removed the patients return to good health. They do not show clinical evidence of hepatitis or cirrhosis.

When an obstructing stone is removed from the common duct and normal biliary drainage again established, even when the patients have been deeply jaundiced and have had chills and fever and evidence of severe infection, if they survive the operation the results are astonishingly good. I have had an opportunity to see a few of these patients years after this operation (ten and fifteen years). They have not developed liver cirrhosis or persistent liver infection.

Clinical evidence seems to suggest a low-grade infection with a tendency for the infecting organisms to die out when conditions favorable to the body cells are created.

All these facts suggest that in gall-bladder disease, other factors than infection must be considered. Alterations in metabolism leading to movable concretions and intermittent obstruction are factors in determining the remitting infection.

Experiments show that repeated intravenous injections of millions of streptococci in rabbits produce cholecystitis and cholelithiasis. Such massive contamination does not reproduce etiological conditions seen in the cholelithiasis and cholecystitis in man.

BACTERIOLOGICAL EXAMINATIONS

By L. FAMULENER AND G. P. PIERSON IN THE BACTERIOLOGICAL LABORATORY OF ST. LUKE'S HOSPITAL

TABLE A—Microscopic examination of gall-bladder wall and bacteriological examination of liver tissue in twenty-seven cases of cholecystectomy for cholecystitis and cholelithiasis

CASE I—C. S., fifty-three years of age. Gall-bladder *Gross*—Wall 1.5 centimetres thick, surface covered with adhesions. Many stones found. *Microscopic*—Sections showed chronic inflammation, papillary hyperplasia, muscular walls invaded with lymphocytes.

Bacteriological Examination—Fragment of Liver—Rather large cocci, probably enterococci. Cultures on blood agar slant, Huntton's and broth showed no growth.

CASE II—E. W., sixty-three years of age. Gall-bladder *Microscopic*—Slight but definitely acute inflammation, mucosa was infiltrated with polymorphonuclear leucocytes. There was oedema in muscle layer with infiltration with round cells.

Bacteriological Examination—Fragment of Liver—Gram-positive, small, slightly elongated diplococci, probably enterococci. No growth on culture.

CASE III—I. McD., twenty-six years of age. Gall-bladder *Gross*—Wall thick, mucosa thin and eroded. It contained many stones. *Microscopic*—Section showed chronic productive inflammation and an acute hæmorrhagic inflammation of inner coats, muscles infiltrated and contained a considerable number of polymorphonuclear leucocytes.

Bacteriological Examination—Fragment of Liver—Negative.

CASE IV—M. S. fifty-seven years of age. Gall-bladder *Gross*—Wall thick, many stones. *Microscopic*—Sections showed chronic productive inflammation with thickening and distortion of wall, many glands buried beneath muscle, making cysts. Round-celled infiltration in all coats.

Bacteriological Examination—Fragment of Liver—Negative.

CASE V—B C, thirty-four years of age Gall-bladder *Gross*—Surface smooth and glistening, mucosa flat and granular, wall thickened and œdematous, small stone present *Microscopic*—Sections showed considerable digestion of mucosa, degenerative changes in the muscle and very slight evidence of chronic infection Few buried glands in the muscle suggesting an old process, now quiescent Practically no infiltration

Bacteriological Examination—Fragment of Liver—Negative

CASE VI—M L, thirty-eight years of age Gall-bladder *Gross*—Peritoneal surface was wrinkled and gray, mucosa finely granular, wall thickened *Microscopic*—Sections showed very slight degree of chronic inflammation in the mucosa and muscle and slight infiltration of subserous fat and fibrous tissue Very little productive lesion in any of these coats Mucosa fairly well preserved The lymphoid infiltration was practically the only lesion

Bacteriological Examination—Fragment of Liver—On the fifth day Gram-positive, short, thick, bacillary form developed in the autolyzing liver Reculture growth on blood agar slant, and Hinton's medium very thin and translucent, probably a diphtheroid type

CASE VII—T L, thirty-eight years of age Gall-bladder *Gross*—Wall thickened There were many stones *Microscopic*—Sections showed slight alterations, some œdema and round-celled infiltration of all the coats There were a few buried glands in the muscle, probably also an inflammatory process

Bacteriological Examination—Fragment of Liver—Negative

CASE VIII—C S, fifty-eight years of age Gall-bladder *Gross*—Surface was diffusely granular and punctately injected, wall thick, gray, œdematous, mucosa thin, granular and had a hæmorrhagic, fibrinous exudate adherent to it A few stones were enmeshed in this *Microscopic*—Sections showed thickening due to productive inflammation involving all coats The process was subacute in the mucosa where desquamation and ulceration were evident, the ulceration extending through the muscle in places

Bacteriological Examination—Fragment of Liver—Negative

CASE IX—J McA, thirty-five years of age Gall-bladder *Gross*—Serosa was injected and hæmorrhagic and coated with delicate adhesions, wall thickened, mucosa eroded and ulcerated There were a few stones *Microscopic*—Sections showed a marked chronic inflammatory process with an extensive productive lesion which had resulted in deposition of much new tissue outside the muscle coat Muscle was degenerated, mucosa thickened and œdematous Subserous coat was hyaline, few round cells infiltrated it

Bacteriological Examination—Fragment of Liver—Negative

CASE X—D F, twenty-four years of age Gall-bladder *Gross*—Serosa thick, wall thickened and mucosa thick and velvety There were many stones *Microscopic*—Sections showed inflammation affecting all the coats, each being involved in a mass of productive inflammation The tissue was infiltrated with lymphocytes and was myxomatous throughout The epithelium was well preserved, mucosa thickened

Bacteriological Examination—Fragment of Liver—Negative

CASE XI—L K, fifty-five years of age Gall-bladder *Gross*—Eight small faceted stones had ulcerated through the wall and protruded from the surface, covered by a thin layer of serosa Wall was thin, mucosa atrophic There were many stones The mucosa had completely regenerated and was smooth beneath the stones which had ulcerated through *Microscopic*—Sections showed a productive lesion of the mucosa and all the coats were undergoing secondary atrophy There was a round-cell infiltration of the remaining glands, a few of which were dilated and others atrophic The muscle showed fewer changes but there was an old productive inflammation outside of it

Bacteriological Examination—Fragment of Liver—Negative

CASE XII—E H, sixty-three years of age Gall-bladder *Gross*—Serosa was roughened by old adhesions Wall was œdematous and thick, mucosa thin and eroded *Microscopic*—Sections showed a thinning and desquamation of the epithelium The underlying muscle was diffusely infiltrated with round cells and a few polymorphonuclear leuco-

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cytes The muscle coats were separated by dense hyaline connective tissue The surrounding connective tissue was œdematous and showed numerous small groups of round cells Stones were present

Bacteriological Examination—Fragment of Liver—Negative

CASE XIII—E F, twenty-five years of age Gall-bladder *Gross*—Gall-bladder was ten centimetres long, serosa smooth, wall two centimetres thick There were many stones *Microscopic*—Sections showed diffuse chronic inflammation with a slight productive lesion and many degenerative changes in the newly-formed tissue, which penetrated all the coats to a slight extent Lymphocytes in all the coats, muscle thinned mucosa dilated

Bacteriological Examination—Fragment of Liver—Autolyzing liver negative, liver in Rosenow's medium showed staphylococcus

CASE XIV—M B, thirty-one years of age Gall-bladder *Gross*—Wall was thick and rough, mucosa ulcerated *Microscopic*—Sections showed destruction of nearly all the normal structures and infiltration of remaining epithelium and muscle There was an ulcer on the surface, the base being formed by granulation tissue which was infiltrated with polymorphonuclear cells, and there were many giant cells and large masses of bile pigment deeply buried in the tissue There were many stones

Bacteriological Examination—Fragment of Liver—Mass for autolysis showed no growth after ten days' incubation

CASE XV—M S, fifty-three years of age Gall-bladder *Gross*—Wall was thin, small cystic area 1.5 centimetres in length in wall Stones present *Microscopic*—Sections showed thickening of mucosa in the diverticulum with some papillary outgrowths but very little exudative inflammation Sections of the adjacent wall showed chronic inflammatory changes with some productive inflammation and atrophy of portions of the mucosa and cystic dilated glands There was considerable fibrous and lymphocytic infiltration throughout

Bacteriological Examination—Fragment of Liver—Negative after six days incubation

CASE XVI—A W, sixty-three years of age Gall-bladder *Gross*—Omentum wrapped about region of gall-bladder Much fresh exudate present in the region Gall-bladder was nine centimetres long, serosa hæmorrhagic, mucosa the same, with ulcerations, wall thick and œdematous There were many black faceted stones *Microscopic*—Sections showed a marked productive inflammation and thickening of entire wall, due chiefly to cellular fibrous tissue containing endothelial cells, deposited outside the muscle layer Hæmorrhage, œdema and round-cell infiltration were present

Bacteriological Examination—Fragment of Liver—Gram-negative bacillus identified as bacillus coli communis

CASE XVII—M P, twenty-six years of age Gall-bladder *Gross*—Gall-bladder was eight centimetres long, cystic duct slightly dilated and completely filled with small faceted stones *Microscopic*—Sections showed the wall thinned and atrophied, a very slight round-cell infiltration was present There had been a little thickening outside the muscle

Bacteriological Examination—Fragment of Liver—Negative

CASE XVIII—E K, thirty-two years of age Gall-bladder *Gross*—Fifty stones were present Serosa and mucosa were normal *Microscopic*—Sections of wall showed comparatively slight changes There was some desquamation of the epithelium Very few infiltrating cells could be found and no active inflammatory process could be made out

Bacteriological Examination—Fragment of Liver—Negative

CASE XIX—J W, forty-seven years of age Gall-bladder *Gross*—Gall-bladder was eight centimetres long Serosa smooth and opaque wall thick and œdematous, mucosa velvety *Microscopic*—Sections showed very poorly preserved tissue with a slight amount of chronic inflammation in the muscle and subserous tissue

Bacteriological Examination—Fragment of Liver—Negative

CASE XX—L S, thirty-seven years of age Gall-bladder *Gross*—Serosa smooth and white, wall 0.2 centimetres thick, twenty-five stones present *Microscopic*—Sections showed a chronic inflammation of moderate degree with slight thickening, hyperplasia of the mucosa and a slight productive lesion in it

Bacteriological Examination—Fragment of Liver—Very few Gram-negative bacilli on smear after forty-eight hours, unable to recover for growth and identification

CASE XXI—C W, twenty years of age Gall-bladder *Gross*—Gall-bladder seven centimetres long, serosa oedematous and slightly hæmorrhagic, wall thickened by oedema and yellowish exudate Mucosa was thin, hæmorrhagic and partially ulcerated and showed small amount of fibrin Cystic duct was dilated and contained a faceted stone Five other stones were found *Microscopic*—Sections showed considerable thickening due to a productive lesion which had involved all the coats The mucosa was hæmorrhagic, stroma infiltrated with fresh blood The muscle wall and other coats contained a large number of round-cells and a few polymorphonuclear cells, but the largest amount of thickening was due to the deposited new tissue outside the capsule

Bacteriological Examination—Fragment of Liver—Negative

CASE XXII—M S, fifty-one years of age Gall-bladder *Gross*—Surface was smooth and pale, wall slightly thickened, mucosa thin There were many stones *Microscopic*—Sections showed very slight inflammatory changes with slight thickening due to productive inflammation outside the muscle and to a slight infiltration with lymphocytes throughout The muscle was degenerated and atrophic epithelium desquamated

Bacteriological Examination—Fragment of Liver—Negative

CASE XXIII—C P, thirty-four years of age Gall-bladder *Gross*—Gall-bladder was adherent to the duodenum and omentum Serosa was thick and opaque, wall one centimetre thick Mucosa was hæmorrhagic, several stones were present *Microscopic*—Sections showed thickening in some areas and thinning in others Muscle was hypertrophied, oedematous and hyaline and infiltrated with polymorphonuclear cells

Bacteriological Examination—Fragment of Liver—Negative

CASE XXIV—L F, thirty-eight years of age Gall-bladder *Gross*—Serosa was smooth, wall slightly thickened Mucosa was dull About thirty stones were present *Microscopic*—Sections of the wall showed it thin and atrophic and there was very slight chronic inflammation in all the coats with a little productive tendency and slight round-cell infiltration throughout

Bacteriological Examination—Fragment of Liver—Negative

CASE XXV—J W, thirty-six years of age Gall-bladder *Gross*—Wall was 1.2 centimetres thick and the duct equally so Serosa was granular and hæmorrhagic, wall firm and yellowish Mucosa was hæmorrhagic and largely eroded, calculi present *Microscopic*—Sections showed an acute process superimposed upon a chronic one, with ulcerations in the mucosa and suppurating areas underlying them The muscle was perforated and there were extensive hæmorrhages with polymorphonuclear infiltration and an early productive lesion Thickening due chiefly to new tissue outside the muscle

Bacteriological Examination—Fragment of Liver—Negative

CASE XXVI—T L, forty-four years of age Gall-bladder *Gross*—Gall-bladder was distended, serosa dull, peritoneum thickened and oedematous There was a large stone in the ampulla Mucosa was diffusely hæmorrhagic and showed areas of yellowish fibrinous exudate *Microscopic*—Sections showed a well-marked degree of thickening due to a subacute inflammatory process which involved the entire wall Most of the epithelium was eroded and hæmorrhagic, fibrin and granulation tissue replaced it Muscle was also necrosed and infiltrated with eosinophiles, polymorphonuclear leucocytes and lymphocytes Outside the muscle there was also a thick cellular layer of new tissue

Bacteriological Examination—Fragment of Liver—Negative

CASE XXVII—L DeF, twenty years of age Gall-bladder Not examined

Bacteriological Examination—Fragment of Liver—Negative

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TABLE B—*Bacteriological examination of bile in patient with carcinoma of the head of the pancreas*

CASE—A T, sixty-seven years of age *Bacteriological Examination*—Bile—Cultured on Rosenow's medium and blood agar slant, after forty-eight hours' incubation showed small colon-like Gram-negative bacilli which took an uneven stain could not be recovered for growth

TABLE C—*Section of liver from patient with cholecystitis and cholelithiasis and stones in the common duct*

CASE—F P, thirty-eight years of age Gall-bladder *Gross*—Wall was thick mucosa eroded, there were many stones *Microscopic*—Section showed marked degree of inflammation with exudation in all coats

Bacteriological Examination—Fragment of Liver—Section of liver undergoing autolysis showed numerous Gram-positive diplococci and Gram-negative bacillary forms These were identified as bacillus coli communis (3 culture test) and enterococcus but the enterococcus was of lower thermostability than usual (killed by heating at 58°–59° C for thirty minutes)

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SURGERY OF THE PANCREAS

AT THE ROOSEVELT HOSPITAL FROM 1918 TO 1928 *

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THOUGH disease of the pancreas, amenable to surgical relief, is rare, it occurs frequently enough for a surgeon to feel the need of keeping posted on the best methods of treatment To see what could be learned of the pancreas from hospital case histories I have reviewed those records at the Roosevelt Hospital from 1918 to 1928 The study may be of some interest and I hope provoke profitable discussion

Acute Pancreatitis—So far as we now know acute pancreatitis, acute hæmorrhagic pancreatitis, acute pancreatic necrosis, suppurative pancreatitis and abscess of the pancreas probably are varying degrees of pathology from the same exciting cause The symptoms when marked are fairly well appreciated, but the etiology is still under discussion and the last word, we hope, has not yet been said as to treatment

Of the etiology Professor Von Schmieden and Doctor Sebening, of Frankfurt, from a study of their cases and of the literature and of answers to a questionnaire covering 2137 cases treated, say that the association of cholelithiasis and acute pancreatic necrosis is more than coincidental From their questionnaire replies, 894 or 69·8 per cent of the 1278 cases operated upon, had simultaneous gall-stones, and of these 174 were in the common duct and fifty-seven in the papilla But of their own thirty-eight cases where search for the stone was most thorough thirty-one, or 81 per cent, had cholelithiasis with fifteen in the common duct and seven in the papilla They believe that stones signify the probability of a flow of bile into the duct of Wirsung either by lodging in the papilla or by a spasm set up blocking it The stone need not be found at operation as it may have passed into the intestine But during its passage back flow may have occurred or duodenal contents have gained entrance through the dilated papilla and entered the duct of Wirsung

Von Schmieden reports the literature as showing that fifty cases of invasion of the duct of Wirsung by ascariides had results similar to those in cases with stone incarcerated in the papilla, and gives the details of a case of his own Infection through the lymphatics or the blood stream is still given as a cause, though most probably a theoretical one Eggers could find no evidence of bacteria in the fat necrosis or in the peritoneal exudation of six cases he studied Operative trauma is listed as another cause Such operations as partial excision of the pancreas for adherent ulcer or for biopsy, as partial gastrectomy with burial of the duodenal stump in the head of the

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pancreas, as splenectomy with ligation of the tail of the pancreas, all have been followed by the disease

The symptoms in the severe case may be easy of interpretation, but in milder ones very difficult. The disease often starts in like previous attacks of gall-stone colic, the pain suddenly becoming excruciating and constant, little if any relieved by morphine, and causing the patient to toss and turn seeking some position of relief. It radiates as in gall-stone colic, but may be girdle-like. It is most intense to the left of the mid-line if the body and tail of the pancreas alone are involved. Vomiting is severe, frequent and continued. Shock ensues quickly. The fever varies from subnormal to 103° , depending on the intensity of the process.

The physical signs are upper abdominal distention, but not so marked as that of peritonitis or ileus, tenderness and sometimes the palpation of a mass. Occasional signs are icterus, cyanosis of face and extremities, glycosuria and fatty stool, though there is generally absence of bowel movements or even flatus. The leucocytes vary from normal to 15,000 or more, with 85 per cent to 90 per cent polymorphonuclears.

Of a total of 57,336 admissions during the ten-year period there were nine cases of acute pancreatitis. All were operated upon but one, a married woman of thirty-five years, who three months before had a pleurisy with effusion, nine weeks later a return of pleuritic pains followed by sudden band-like abdominal pain, persistent vomiting, cyanosis, tenderness in the epigastrium and shock. She died within twenty-four hours. Autopsy showed acute hæmorrhagic pancreatitis and tuberculous pleurisy. Two others died after operation, both with pulmonary complications. One of these had a cholecystostomy with removal of stones from the gall-bladder and drainage to the pancreas but without incision of the overlying peritoneum, the other, the only one with a previous gall-stone history, had a cholecystectomy, incision of the common duct and removal of several stones, but no drainage of the pancreas. Of the recoveries one had incision and drainage of the pancreas, one had drainage only, three had cholecystostomy with extraction of stones and one had no intraperitoneal procedure.

The treatment of acute pancreatitis in the milder degrees may be watchful waiting, but otherwise is operative. The peritoneum over the pancreas should be incised or torn to give escape to the activated pancreatic juice, thus helping to prevent its retroperitoneal spread, then limiting its activity in the peritoneal cavity by drains and tampons. With the associated gall-bladder disease, and even without the discovery of stones, but because of the frequent connection of the two conditions the gall-bladder or common duct should be drained. Cholecystectomy alone would be inadvisable because of increased bile pressure. The more elaborate operations of anastomoses the gall-bladder or common duct to duodenum or stomach would be out of order owing to the added time of operation, the poor adhering qualities of the serosal surfaces around the inflamed pancreas and because sutures would be unreliable.

Chronic Pancreatitis—Sailer writing in 1910, says of the pathology of chronic pancreatitis that "the ordinary form, as in all other forms of chronic inflammation, consists of degenerative changes in the cells and proliferation of the connective tissue associated with round-cell infiltration." The etiology is the same as for acute pancreatitis and often follows the latter. Certain general infectious diseases cause chronic pancreatitis, such as the type described in the newborn suffering from hereditary syphilis. Of the symptomatology Sailer says it resolves itself practically into

(a) Some discomfort apparently associated with the stomach (b) evidence of indigestion, (c) pain of any degree or variety, sometimes in the neighborhood of the umbilicus and sometimes elsewhere in the abdomen. Of the more definite signs occasionally there are (d) jaundice (e) a distended gall-bladder, and (f) a more or less evident mass in the region of the umbilicus.

Of these cases there were nine, having therefore, the same incidence as the acute form. She has symptoms referable to the gall-bladder as pain in the gall-bladder region radiating to the side or back, nausea, vomiting and two of these had jaundice. The operative procedure in two cases was cholecystectomy, in four cases cholecystostomy. The provisional diagnosis had been cholelithiasis in all though three only had stones and the enlarged hard pancreas was a surprise finding. Of the remaining three, one had upper abdominal pain and a mass which was thought to be pancreas. Exploratory operation confirmed the diagnosis, but nothing further was done. One had a four-year history of indigestion, upper abdominal pains in winter, occurring four hours after meals, relieved sometimes by warm drinks. Jaundice developed and clay-colored stools appeared. Exploration revealed a normal gall-bladder and ducts, induration of the pylorus and an enlarged nodular head of the pancreas. Twenty-seven months later this patient was symptom free and had gained forty pounds. The final case had a three months' history of non-radiating umbilical pain, jaundice, and four to eight putty colored movements a day and a loss of forty pounds in weight. No free hydrochloric acid showed in a test meal. Exploration for obstructive stone showed a thick, grayish gall-bladder which was removed, a chylous liquid in the peritoneal cavity and an enlarged head of the pancreas. About once a month thereafter a paracentesis aspirated quarts of this chylous liquid. He died in six months, possibly of carcinoma of the pancreas.

The treatment of chronic pancreatitis for the most part is a matter of attending to the associated biliary disease. Drainage of the gall-bladder may be followed by remarkably good results. Otherwise the treatment is symptomatic, directed mostly toward combating indigestion.

Cysts of the Pancreas—A classification of pancreatic cysts by Robson and Moynihan is as follows:

(1) Retention cyst, (2) proliferative cyst, cystic adenoma, cystic epithelioma, (3) hydrated cyst, (4) congenital cystic disease, (5) hæmorrhagic cysts, (6) pseudocysts.

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Primrose says to this must be added dermoid cysts as a result of a recent communication by Judd in which he describes a cyst, arising in the body and tail of the pancreas, containing hair and one tooth. Pseudocysts are most probably traumatic and develop in the lesser sac the connection to the pancreas not being very certain.

The etiology is still obscure, but the most common causes are chronic interstitial pancreatitis, biliary disease, and trauma. The cysts occur at any age, about equal in the sexes, though in this series there were five women to one man, and may or may not contain pancreatic ferments. Opic states "The presence in cystic contents of one or more enzymes resembling those of the pancreas was formerly believed to give proof that a cyst had its origin in the pancreas. Not infrequently one or perhaps all of these enzymes are absent in the contents of a pancreatic cyst, whereas fat-splitting diastatic or proteolytic enzymes are found in fluids not derived from the pancreas." In one of our cases the fluid examined for enzymatic action was positive.

The symptomatology of pancreatic cyst is dependent on the precedent causative disease, such as biliary calculi and pancreatitis, on its size and weight and fixation to neighboring organs, or on sudden increment. Pain across the abdomen, sharp, of short duration, and maybe radiating downward or to the back, is frequent. Loss of weight, indigestion, nausea, vomiting and constipation are more infrequent. The cyst may be firm or fluctuant, fixed or movable, local or extending from diaphragm to pelvis.

Our records show six cases of cysts of the pancreas, all but one in women, the youngest a woman of twenty-nine years. Confirmation of one was by operation elsewhere. In another operated upon for relief of intestinal obstruction due to ventral hernia, who died of meningitis, the cysts, dilatations of the pancreatic ducts, were found at autopsy. The third case undergoing salvarsan treatment developed jaundice and a palpable epigastric tumor. His gall-bladder was removed for stones, and a preliminary walling off by tampons of the cyst of the pancreas was done and the cyst aspirated and drained a week later. He died after nineteen days and autopsy disclosed a stone in the papilla of Vater, necrosis of fat and of the head of the pancreas. The fourth case had lost fifty pounds weight in five months and showed a large epigastric mass extending to the navel, firm and slightly movable. This mass in the head of the pancreas was aspirated, yielding three quarts of green liquid, then opened and the clots removed and the cyst wall sutured to the abdominal wound. Death followed twelve days later with acetone and diacetic acid in the urine. The fifth case was a hemorrhagic cyst, but its connection with the pancreas was not certain. The clots were turned out and the cavity drained. In the last case after aspiration of the cyst the wall was excised rather easily.

In regard to treatment Primrose reported a case in which he opened the posterior parietal peritoneum and sutured its edges to those of the anterior parietal peritoneum at the site of the incision and then drained

the cyst retroperitoneally, so to speak. This method he had not seen described, the usual one being to suture the wall of the cyst to the anterior parietal peritoneum or to the skin. It seems probable that the peritoneum overlying a cyst is often not distinguishable as a separate structure from the cyst wall and is sutured with it to the anterior wound. Whether one totally or partially extirpates these cysts or drains them depends on the character of the cyst. Gobell is quoted as giving a 10.7 per cent mortality for total extirpation and 55.5 per cent for partial extirpation. If the cyst is too firmly adherent to adjacent viscera or too broad based and deep in the pancreas it is better to drain. If the posterior peritoneum is free it should be sutured to the anterior incision, or if not the incised edges of the cyst wall should be sutured there.

Pancreatic Calculi—Though no cases of pancreatic calculi occurred in the ten-year period of this paper the records of two, in 1914 and 1917, are inserted for the sake of completeness.

Seeger in 1925 looked up all the cases of pancreatic calculi in the literature, ninety-nine, of which twenty-two had been operated upon, and added his own operative case. Of these twenty-three operative cases two died, a mortality of 8.5 per cent. Calcium carbonate is an important constituent of pancreatic calculi, but as the normal pancreatic secretion contains none of this substance the formation is attributed to an altered secretion. Ligation of the pancreatic ducts fails to produce them. They are whitish or gray, but at the papilla may obtain a coating of bile.

Sistrunk reported five cases from the Mayo Clinic, included in Seeger's series of twenty-three. He says pancreatic calculi are often multiple and frequently associated with diabetes, that the symptoms are indistinguishable from those of biliary colic, that the surgeons routinely examining the pancreas at operation rarely find them, though they occur once in every 1500 autopsies, that multiple stones may give a sense of crepitation on palpating the pancreas.

Three of Seeger's operative series had passed pancreatic calculi per rectum. One of these was a patient of Doctor Dowd, whom he showed before this Society in March, 1915. Doctor Dowd opened an indurated area in the head of the pancreas and drained out, in a whitish pus about thirty soft, small stones. The pus later showed a staphylococcus growth.

Of the two cases at the Roosevelt Hospital, the first was a man, of forty-two years, who had been operated upon three years previously for acute pancreatitis. His present admission was for acute intestinal obstruction from which he died without operation. Autopsy showed the obstruction in the duodenum from adhesions of the previous operation and the pancreatic ducts full of stones, completely blocking the outlet to the intestine. The gall-bladder and biliary ducts were normal. The second case a man, of thirty-eight years, had for four months right hypochondriac pain, cramp-like, radiating to the epigastrium, made worse by eating and relieved somewhat by a bowel movement. Jaundice and clay-colored stools had

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been present for two and a half months. The patient had lost thirty-three pounds. The liver was enlarged to the umbilicus and the gall-bladder was palpable. At operation the pancreas was examined through a slit in the gastrocolic omentum and the head found enlarged. It was incised and a stone extruded. The incision was enlarged, deepened and drained. A choledochoduodenostomy was then done. Patient left the hospital on the thirty-eighth post-operative day, but a month later returned and died of diabetes. Autopsy showed multiple calculi in the pancreas surrounded by pus with very little normal pancreatic tissue left.

Seeger says his collected operative series demonstrated that the action of the pancreatic juice on the tissues is not to be considered dangerous. In two cases which died no evidence of fat necrosis was found nor was any other complication present which was due to the fact that pancreatic tissue had been worked on. In no case of removal of stones did a permanent fistula develop.

Carcinoma of the Pancreas—In this ten-year period there were twenty-two cases of carcinoma of the pancreas, thirteen in females and nine in males, reversing the sex incidence of Herringham (quoted by Speed) of five males to one female, and of Speed of thirty-six males to sixteen females. Of those whose ages were specified all but three (34, 37 and 45) were between fifty and sixty-seven. The duration of illness was a matter of six months or less, and often of only a few weeks. Eleven died in the hospital. The most constant symptoms were loss of weight, 79 per cent, pain, 73 per cent, jaundice, 63 per cent, and weakness, 61 per cent. Loss of weight is marked, ten to fifty pounds in a couple of months and is usually accompanied by feebleness. Pain in the early part of the disease is occasional and not severe, but increases in frequency and severity until almost constant. It varies from a gnawing or rolling sensation to a cramp-like pain and may radiate across the abdomen or into the back. Jaundice appears late and is steadily progressive. Of other symptoms nine had some degree of indigestion, gas, belching or vomiting, two had constipation, and one diarrhoea. There were two cases of diabetes and two had ascites.

In over a third of the cases an abdominal mass other than an enlarged liver or spleen was palpated. X-ray findings in eight cases were suggestive of tumor of the pancreas and in three of them the diagnosis was unequivocal. Findings considered suggestive are defects of pyloric filling which the roentgenologist recognizes as extragastric, a widened duodenal arch, or stasis in the duodenum.

Revealed at operation or autopsy the tumor was in the head of the pancreas except in two cases, and these were in the body. The growth was often most extensive, including the liver, gall-bladder and ducts, the stomach, duodenum and omentum.

Little can be done for these patients. Nineteen were operated upon, two had cholecystogastrostomy and one cholecysto-enterostomy which cleared up the jaundice, three had cholecystostomies, and one a gastro-enterostomy.

because of obstruction at the pylorus Cholecysto-enterostomy or cholecystogastrostomy is the procedure of choice when possible since these patients fail rapidly when external drainage of bile is instituted Speed says "I have not found in the literature successful complete pancreatectomy in cancer of the pancreas Some operators have considered that they have performed complete pancreatectomy, but autopsy has disproved their belief Partial pancreatectomy can be successfully done We must recall that a large percentage of the patients are deeply jaundiced Blood coagulation time is greatly increased up to eight or even ten minutes, so that operative procedures are hazardous The leaking of pancreatic secretion after operation in the abdominal cavity always results in death Exudate from the injured pancreas which is not the normal secretion prevents the formation of salutary peritoneal adhesions, and catgut stitches are rapidly digested Pancreatic juice mixed with blood is very toxic and when introduced into the peritoneal cavity will cause death without the aid of infection "

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LEFT VAGUS SECTION AND PARTIAL GASTRECTOMY FOR DUODENAL ULCER WITH HYPERACIDITY

(PRELIMINARY REPORT)

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THE theory of partial gastrectomy for gastroduodenal ulcer is based on two principles (1) The operation removes the ulcer and the region in which ulcers most commonly occur In gastro-enterostomy on the other hand, the ulcer is left *in situ* and may or may not heal (2) Free hydrochloric acid in the gastric contents is usually markedly reduced or eliminated We believe that gastrojejunal or jejunal ulcers rarely, if ever, form in an anacid medium Both of these principles have been fully discussed in previous papers ¹

There are four phases of gastric secretion They are briefly as follows

1 The primary (cephalic, psychic) Gastric secretion follows the sight, smell, taste or chewing of food The stimulus to secrete is carried to the stomach over the vagus nerves and ceases if these are severed

2 The secondary (gastric) The presence of the products of protein digestion in the stomach produces a secondary stimulus to secretion before the primary phase ends These protein products do not directly stimulate the acid glands which are situated in the body and fundus They act upon the antrum or distal third of the stomach in some unknown way and cause the liberation into the blood of substances that stimulate the acid cells ² The operation of partial gastrectomy removes the antrum of the stomach and hence the site of stimulation for the secondary phase

3 The intestinal This starts about three or four hours after the administration of food ³

4 The continuous In a large number of individuals there is a continuous secretion of acid into the stomach without any apparent stimulus The amount varies widely in different individuals and also in the same individual from time to time We do not know the mechanism of this secretion but it seems possible that it reaches the stomach over the vagi ⁴

In a previous paper the acid ⁵ findings following the operation of partial gastrectomy were discussed Table I shows the results obtained

Although there was a marked reduction in the acid contrary to a widely prevalent belief, the operation did not produce anacidity in the large majority of the duodenal ulcer cases Following the operation there is usually an immediate reduction of the acid figures There then follows a further progressive fall in the acidity for a period of six months or longer After six months 25 per cent of the patients who had had a partial gastrectomy for duodenal ulcer showed anacidity and 41 per cent hypo-acidity The

unpleasant fact remained that 17 per cent of the patients still had hyperacidity. These were cases in which very high acid figures were present before operation. Evidently the removal of the second phase of gastric secretion by partial gastrectomy was not in itself sufficient to bring about a hypo-acidity or anacidity.

TABLE I

Maximum Free Acid After Partial Gastrectomy in Fractional Test Meals

	Anacid	0 to 20	20 to 50	50 and above	Number of Cases
Duodenal					
Before operation		4%	36%	60%	50
Recent	9%	9%	46%	36%	11
Old	25%	41%	17%	17%	12
Gastric					
Before operation		28%	60%	12%	25
Recent	45%	33%	11%	11%	9
Old	100%				3
Gastrojejunal					
Before operation		11%	67%	22%	9
Recent	25%	25%	50%		4
Old	50%		50%		2

"Recent" refers to cases examined immediately after operation, "old", to cases examined six months after operation. "before operation" in gastrojejunal group refers to cases examined before partial gastrectomy.

To all those who have studied the problem of gastroduodenal ulcer there has undoubtedly come the realization that the disease varies through all grades of intensity. On the one hand there are those with an exceedingly mild form of ulcer, and on the other hand, those in whom a tendency to recurrence clings so tenaciously that it defies all manner of therapy. On the one extreme are the ulcers found at autopsy that have healed spontaneously with little or no symptoms, and on the other, cases such as those of Haberer⁶ or Holst,⁷ where repeated resections higher and higher on the stomach were necessary to effect cures. This means that the tendency toward healing varies in different individuals. It accounts for the fact that medical care and the less radical procedures are followed by healing in some, and that the more radical operation of partial gastrectomy is necessary in others. We have at present no means of segregating these groups before operation. In order, therefore, to insure the largest number of cures many surgeons perform the operation of partial gastrectomy routinely. We do feel that the tendency to recurrence is most marked when the pre-operative acidity is very high in the Rehfuess test and when the patient is the so-called highly "nervous" type. It was, therefore, with much disappointment that we noticed the persistence of hyperacidity in 17 per cent of the duodenal ulcer cases six months after partial gastrectomy.

Was there any other measure that could have been instituted to insure anacidity? Partial gastrectomy removed the second phase of acid secretion

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That left the primary, the intestinal and the continuous phases. Was it possible to eliminate any of these phases? Obviously to influence the intestinal phase would have been very difficult. This narrowed our attention to the primary and the continuous. The primary phase undoubtedly acts over the vagus nerve and it seems likely that the continuous secretion results from the stimuli coming down the same pathway. Section of the vagi therefore would have eliminated the primary and perhaps the continuous secretion. A very large number of observations have shown that experimental section of both vagus trunks at the level of the cardia is not followed by any permanent ill effects.⁸ It was deemed safer however, after experimental work to be discussed in a subsequent communication, to section only the left vagus in man. This nerve sends branches to the anterior half of the body and fundus of the stomach and presumably influences the acid cells located in these parts. The operation has now been done eight times by Dr. A. A. Berg. The trunk of the left vagus is sectioned near the cardia. The procedure is not difficult and adds only a few minutes to the gastrectomy. If the lesser curvature is placed on the stretch the nerve can be felt as a taut, inelastic strand. The cases that have been chosen are those in which the Rehfuess test showed a marked hyperacidity before operation and which we had reason to expect, from previous experience, were likely to remain acid after the resection.

TABLE II

Patient	Date of Operation	Pre-operative Acidity	Acidity Three Weeks Post op	Last Test Meal
1 L G	5/19/28	112-122	16-34	0-40-11/10/28
2 M B	6/2/28	106-114	0-14	0-12-10/19/28
3 L M	6/6/28	88-110	0-78	0-12-10/29/28
4 A H	7/18/28	62-72	0-38	0-16-10/18/28
5 H K	8/8/28	140-150	42-54	0-20-10/19/28
6 H P	8/29/28	90-102	0-44	0-18-10/19/28
7 S L	9/1/28	80-96	24-40	0-18-10/21/28
8 S B	9/29/28	74-86	18-34	0-12-11/10/28

The figures represent the highest free and total acidity in the Rehfuess test (three hours) before operation, three weeks after operation, and shortly before completion of this report. The dates in the last column indicate the date on which the last test was done.

All of the patients at present show a gastric anacidity. In every case a Rehfuess test has been carried out for a period of three hours. Table II shows the highest acid figures in the test before operation, three weeks after operation and shortly before completion of this report. The last tests have been done from two to five months after operation, depending upon the time which has elapsed. The phenomenon of the progressive reduction in acidity mentioned above is again noted. But whereas after partial gastrectomy for duodenal ulcer only one quarter of the patients were anacid even after six months, after left vagus section plus partial gastrectomy eight consecutive cases were all anacid after a much shorter interval. Furthermore, these latter cases unlike the former were chosen only from patients with very high pre-operative acidity.

At present none of the patients have any gastric symptoms. All are well nourished and have gained weight. The procedure has not been attended by any mortality.

No conclusions can be drawn from so small a group. Should the operation, however, furnish a method to produce an anacidity in duodenal-ulcer patients with marked hyperacidity it may prove of value. We do not believe any recurrence would take place under such conditions. This preliminary report is presented in the hope that others may be willing to use the procedure and report their results.

SUMMARY

Section of the left vagus at the level of the cardia in addition to partial gastrectomy has been performed in eight cases of duodenal ulcer with marked hyperacidity. Whereas after partial gastrectomy alone only one quarter of the patients are anacid, in eight cases where in addition the left vagus was sectioned all are at present anacid.

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FACTORS OF SAFETY IN RESECTION OF THE STOMACH FOR GASTRODUODENAL ULCERS*

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By RESECTION of the stomach we mean the removal of a little more than the distal half of the stomach including the pylorus and part of the duodenum. In small gastric ulcers, in pyloric ulcers and in duodenal ulcers the central line of dissection is carried just proximally to the reentrant angle. When dealing with gastric or pyloric ulcers, the distal line of dissection divides the lumen just beyond the pylorus. In duodenal ulcers the resection may have to be carried down into the second part of the duodenum. Thus the typical operation for the vast majority of gastroduodenal ulcers removes a little more than one-half of the stomach and should be called partial gastrectomy.

In the very large gastric ulcers and in those cases in which the ulcer is situated near the cardia the upper line of dissection must often be carried to within an inch of the cardia. Thus two-thirds or even four-fifths of the stomach may have to be removed on account of a rare high location of the ulcer. This extensive resection is justly called subtotal gastrectomy.

The term "subtotal gastrectomy" has been abused in recent years. Even pylorectomies and partial antrumectomies have been misnamed subtotal gastrectomies. Thus the erroneous impression has been created that practically the whole stomach is removed in every resection for gastroduodenal ulcer.

Partial gastrectomy is the method of choice in between 80 per cent and 90 per cent of gastroduodenal resections. Subtotal gastrectomies are performed in not more than about 10 per cent of gastric resections.

It must be admitted that partial or subtotal gastrectomy is an operation of considerable magnitude. Even in the hands of a capable surgeon the operative mortality will always be larger, following this type of operation than the immediate mortality following gastro-enterostomy. But resection of the stomach will not be able to compete successfully with gastro-enterostomy nor find universal favor, unless the mortality is kept down at a fairly low level.

I would like to point out quite briefly some of the factors which will insure a greater margin of safety in the procedures of partial and subtotal gastrectomy. While no fixed rules can be laid down and each case must be judged individually, an experience extending over six years has taught me to lay stress on certain factors which are apt to lower the operative mortality.

Can every case of gastric or duodenal ulcer be radically resected? Anybody who has studied the pathology of gastroduodenal ulceration in the post-mortem room must agree that in certain cases this cannot be accomplished without a subsequent mortality. This is especially true in deep duodenal

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ulcers in which the common duct as well as the ducts of Wirsung and Santorini are so intimately involved in the ulcerative process as to preclude radical removal of the lesion. I have seen large crater ulcers of the second part of the duodenum, where the posterior wall of the duodenum had been eaten away, so that the common duct and the pancreatic ducts opened into a common cloaca. It is wiser in such a case to acknowledge that the technical difficulties are practically insurmountable, rather than go through the steps of a radical removal, only to have death follow one or two days after the operation. In cases of this type, which, fortunately, are very rare, simple gastro-

enterostomy or possibly Finsterer's "Resection zur Ausschaltung" ought to be performed.

What is true for very deep duodenal ulcers is similarly true for the very rare instances of

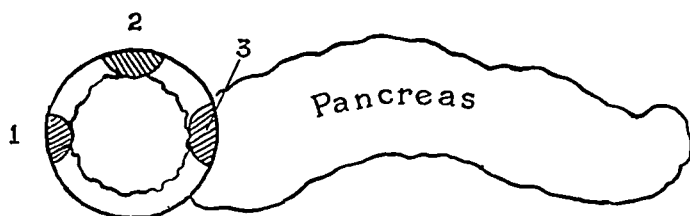


FIG 1.—Location of duodenal ulcers (diagrammatic) 1—Anterior wall 2—Superior wall 3—Posterior wall

gastric ulcers located right at the cardia. These can only be dealt with radically by total gastrectomy. The mortality following total gastrectomy is so very high at present that this operation should be reserved for cases of carcinoma. It is important to emphasize that we have no other surgical means at our disposal to cure these patients. Local excision is impossible and gastroenterostomy is useless. However, I have seen a number of patients with these ulcers who have been quite comfortable for many years, the ulcer disappears and reappears at intervals. The relation of the ulcer to the cardia can be demonstrated by roentgenography.† If cases of this group are encountered on the operating table, it is wiser to desist from a radical removal than to subject the patient to an operative procedure which has at present a prohibitive mortality.

The risks of partial gastrectomy in duodenal ulcer vary considerably according to the location of the ulcer. Ulcers confined to the anterior wall of the duodenum (Fig 1) rarely offer any technical difficulties, especially in a movable duodenum. Dissection is somewhat more difficult in ulcers on the superior wall. The ulcers located on the posterior wall—a very frequent seat for duodenal ulceration—require a very careful dissection. Unless the proper line of cleavage is entered in freeing these ulcers the pancreas may be injured and death ensue from a pancreatitis with fat necrosis. In some cases of this type the duodenum is very friable and great care must be exercised to insure an adequate duodenal closure, for duodenal fistulæ still play an important rôle in the complications augmenting mortality.

It has often been stated that ulcers on the anterior wall of the duodenum should be excised, whereas partial gastrectomy should be reserved for the

† Lewisohn Visualization of the Cardia ANNALS OF SURGERY, vol LXXIII, p 466, 1926

FACTORS OF SAFETY IN RESECTION OF THE STOMACH

ulcers on the posterior wall which cannot possibly be removed by local excision. Aside from the fact that local excision fails to safeguard the patient against recurrent ulcers, it would seem advisable to acquire the technic of partial gastrectomy in the easier cases, namely ulcers of the anterior wall.

Experience is one of the foremost factors of safety in any operation. On palpation an ulcer may be located close to the ducts to make resection a safe procedure. Yet careful dissection of adhesions may show that the ulcer is sufficiently distant from the ducts to render resection safe (Fig 2).

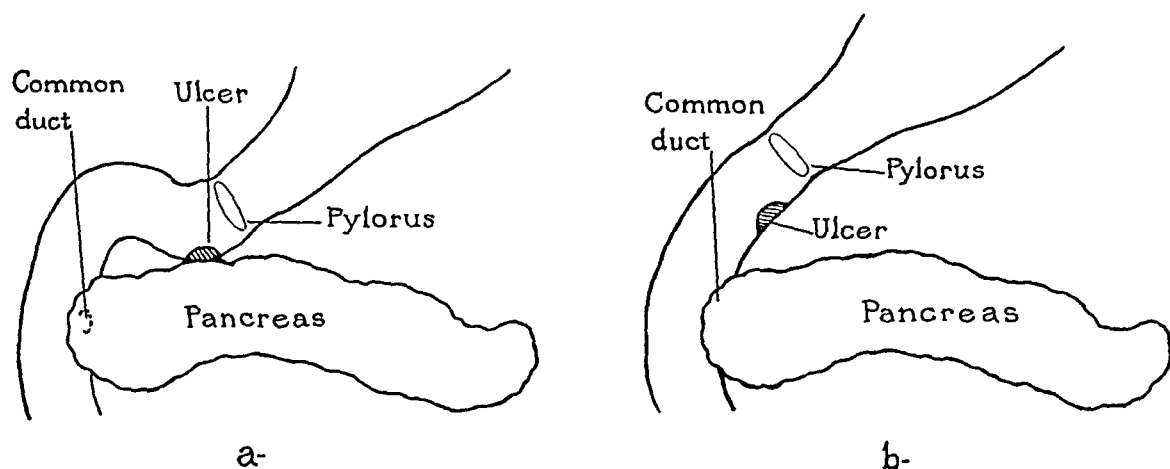


FIG 2—Duodenal ulcer in its relation to the pancreas and common duct, a, before, b, after freeing of adhesions (diagrammatic)

The general condition of the patient is of the utmost importance, as in every other major operation. Severe diseases of the heart, lungs or kidneys present greater contraindications against gastric resection than the age of the patient. A sixty-five-year-old patient in fair general condition may be a good operative risk, while a man of fifty with emphysema and chronic myocarditis might be considered unfavorably for this procedure. In avoiding the use of general anaesthesia, especially ether, as much as possible, patients with healed tuberculosis of the lungs—a frequent coincidence in duodenal ulcers—may be subjected to a gastric resection with a sufficient margin of safety.

Cases with marked pyloric obstruction should not be subjected to an immediate operation. Even though the X-ray examination may appear to present a complete obstruction, the fine lumen still allows some fluids to pass through the intestine. A careful pre-operative preparation by repeated lavages (twice daily), subcutaneous saline infusions and additional fluids by the Murphy drip reduces the operative risk considerably. If the occasion demands, glucose is administered intravenously and blood transfusions are given.

I am a strong believer in pre-operative and post-operative blood transfusion of medium amount (300 to 500 cubic centimetres). The general condition of the patient rather than the haemoglobin estimation should be the guide as to its use. A patient may have a high haemoglobin and yet require the stimulating effect of a transfusion in order to improve his chances for a smooth post-operative course.

In the same way the actual loss of blood during the operation should not be the only index for post-operative blood transfusion. A patient may be

severely shocked after an extensive resection and a transfusion given immediately after the operation or on the following day may aid materially in his convalescence

The proper selection of an anæsthetic is of the greatest importance in gastric operation. General anæsthesia is followed in a large number of cases by post-operative pneumonia which may prove fatal. Splanchnic anæsthesia may cause severe shock. Local anæsthesia, of the abdominal wall, which we used for a number of years does not effect analgesia during the actual resection.

Spinal anæsthesia, which we adopted about one year ago, seems to be superior to any other form of anæsthesia. We use a French preparation called "Neocaine" which is injected between the eleventh and twelfth dorsal vertebræ. The complete relaxation, the perfect anæsthesia, the reduction in post-operative vomiting, and the very smooth post-operative course in the majority of cases have led us to employ this form of anæsthesia in the vast majority of the cases. Time does not permit a discussion of technical details nor the contraindications to its use.

One defect in the application of spinal anæsthesia in its present form is the fact that the anæsthesia does not last more than about fifty minutes. The Billroth No. 2 resection can rarely be finished in that period. Therefore it is often necessary to supplement spinal anæsthesia with gas and oxygen or even some ether. In our experience spinal anæsthesia does not interfere in any way with the use of a general anæsthetic toward the end of the operation. The use of a general anæsthetic over a short period—usually ten to fifteen minutes—seems to have no deleterious effect upon the patient.

We do not hesitate to use the stomach tube on the day following the operation, whenever the symptoms indicate a large post-operative retention. In post-operative hæmorrhages we wash the stomach out with small quantities of ice-water. It is much safer to evacuate a stomach than have a huge dilatation cause tension on the suture lines. I have never seen any harm done by the early use of the stomach tube.

While the vast majority of the patients have a very smooth convalescence and are less disturbed than many gastro-enterostomized patients, some cases will have a stormy post-operative course during the first few days. This group of cases must get careful individual attention. I see these patients at least three times daily in order to recognize any alarming symptoms at the earliest possible moment. Among the rare complications should be mentioned subphrenic and subhepatic abscesses. It is needless to add that these should be drained as soon as the diagnosis is made.

In conclusion I would like to state that after six years' experience with gastric resection in gastroduodenal ulcers I am more than ever convinced that the end-results of partial or subtotal gastrectomy are far superior to those of simple gastro-enterostomy with or without excision of the ulcer. These operations undoubtedly require careful attention to details before, during and after the operation. However, these efforts are amply compensated by the complete restoration to perfect health of the vast majority of the patients subjected to partial or subtotal gastrectomy.

LATE RESULTS IN PERFORATED GASTRO-DUODENAL ULCERS

By LUIS URRUTIA, M D

OF MADRID, SPAIN

WE HAVE operated fifty-two acute perforated gastro-duodenal ulcers in the San Ignacio Private Clinic. Thirty-four of these cases were operated by me personally and the remainder by my associates. There were twelve cases of gastric, thirty-nine of duodenal and one of jejunal ulcer. In seven instances the gastric ulcers were located along the lesser curvature, two in the prepyloric region, one near the cardia, and the remainder at the pylorus.

The perforations were anterior in every case and, excepting one, the ulcers were of chronic type. Three of the patients were women, the remainder men.

In seventeen cases the perforation was sutured with subsequent gastro-enterostomy and in thirty-five cases simple closure of the perforation was the only procedure resorted to. In no case was the peritoneal cavity lavaged. Formerly, the abdomen was invariably drained through a suprapubic tube, but at the present time this is resorted to only when the abdominal cavity cannot be satisfactorily emptied by aspiration.

My personal operative mortality was 17.6, (15.7 per cent for the simple suture and 20 per cent for suture with gastro-enterostomy). Subtotal gastrectomy, a method which has recently gained in popularity in Germany and Austria, has never been performed by us for acute perforations.

As I have already stated in my paper *Sur le traitement opératoire des ulcères gastro-duodenaux perforés* read before the "Société des Chirurgiens de Paris," in 1923, I believe that in cases of perforated gastroduodenal ulcers the operation should be the simplest procedure and should be performed as quickly as possible. I am thoroughly convinced that, as in all emergencies the surgeon ought to limit his activities to the actual problem in hand, reserving the radical cure of the ulcer for a later date, should ulcer symptoms persist.

While we consider partial gastrectomy the most suitable procedure for chronic ulcers, having performed it more than 500 times, we do not feel that an operation of such magnitude should be performed for acute perforations. Such a method can be justified only in a very few cases in which closure of the perforation is impossible because of marked induration, but this indeed must be rather rare. In our cases such a contingency never occurred.

Deaver states that he performed a gastric resection in a patient who perforated while awaiting operation in the ward, but in this case he was practically dealing with one which might be considered clean. Last year we had occasion to operate a patient with a chronic ulcer (not included in this series) and we found upon opening the abdomen a perforated callus duodenal ulcer. Evidently the rupture took place during the administration of the anesthetic and a partial gastrectomy was followed by an excellent post-operative

course. However, this case as well as Deaver's, is the exception rather than the rule.

Bruett has tried to establish certain indications for resections and for palliative operations, relying purely upon the bacteriologic findings. During the first six hours after perforation, the peritoneal exudates are regularly sterile or infected with non-virulent streptococci (enterococci, streptococci viridans), after twelve hours the bacillus coli and the hemolytic streptococci predominate. He concludes that although the exudates may be sterile after twelve hours, as sometimes happens, resection should be practiced only in perforations seen during the first six hours, provided the age of the patient is not over forty-five.

When the cases are more advanced, or the person is older than forty-five, the operative mortality of subtotal gastrectomy is very great. Moreover, we agree with Gibson that the suture for perforation within five or six hours should not be productive of a mortality greater than 5 per cent. On the other hand, I believe that partial gastrectomy is the most suitable treatment for sub-acute perforations. Thus, among eighteen cases which I personally operated, gastro-enterostomy was performed in five and partial gastrectomy in thirteen.

Heussner succeeded in 1892 to cure a perforated gastric ulcer by simple suture. The same method was followed in most of the thirty-three cases recorded by Mikulicz in 1897. Patterson, Deaver, Koerte advised gastro-enterostomy at the time of closure of the perforation.

In our first cases we performed gastro-enterostomy in conjunction with suture of a perforated ulcer. However, I feel that gastro-enterostomy does not improve the chances for a subsequent post-operative recovery. In twelve cases in which we were able to secure a follow-up examination, four required a subsequent operation because of a marginal jejunal ulcer and two others presented recurrent symptoms manifested by pain two or three hours after meals, heartburn, vomiting and hæmorrhage.

This means that secondary ulcer was confirmed by operation in more than 33 per cent in my gastro-enterostomies for acute perforations, and if we base the diagnosis of marginal ulcers on clinical findings the percentage is immediately elevated to 50 per cent.

At a joint meeting of the New York and Philadelphia Surgical Societies in December, 1920, Deaver, who is a strong advocate of immediate gastro-enterostomy, reported fifty-five cases treated by suture with simultaneous anastomosis with three deaths, a mortality of 5.5 per cent. He stated that he had not observed a single case of jejunal ulcer in the series. He considered this possibility exceedingly remote, mentioning the case of Petren as the only one in which this complication occurred. The literature, however, contains other cases and while we do not pretend to give an exhaustive list a few names may be mentioned: Haberer, Bruett (2 cases), Delore, Bolton and Trotter, Winkelbauer (3), W. Stanley Wildmann, Speck (2), Kuntz (2), Enderlen (4), Garnett, Wright, Maylard, Baarhelm, Noetzel

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(3), Schwarz (3), Girling Ball (3), Pool, Biennet, Spath Porzelt Henry Lewisohn, Horowitz, Fromme (2)

We therefore believe that the danger of secondary ulceration after gastro-enterostomy with suture of the perforation is a real one. Among twelve patients treated by closure with gastro-enterostomy, we have two additional cases suffering from epigastric distress and occasional vomiting.

The results in our operated cases have been satisfactory only in four ($33\frac{1}{3}$ per cent), fair in $33\frac{1}{3}$ per cent, bad in $33\frac{1}{3}$ per cent although in three of these a cure was affected subsequently by subtotal gastrectomy. It is for these reasons that we have given up gastro-enterostomy as an additional procedure to simple suture of a perforation. We do not perform it unless the suture of the perforation produces an organic obstruction.

At present many surgeons confine themselves exclusively to simple suture. They are not only satisfied with the immediate results but with the remote results. It is well known that some still believe that spontaneous cure of an ulcer follows acute perforation. Meyer has 13 cures in 14 patients, and these are free from troubles, Crisp-English, 11 among 15, Fordyce, 16 among 27, French, 15 among 18, Southam, 28 among 37, Egbert Schwarz 8 among 10 cases, Fresno and Stincer (Havanna) give the same satisfactory results, the last stating that among 14 cases treated for duodenal ulcer he operated only one, the rest being in perfect condition. Berg confines himself to simple suture in acute perforations and this procedure has given him 70 per cent of cures. Gibson, in his collection of 123 perforations, states that in 123 operations for perforation there was a mortality of 17.4 per cent, in 109 cases simple suture was performed, in fourteen cases supplementary gastro-enterostomy was performed or a similar procedure. Follow-up results were obtained in ninety-three cases, twenty-one were re-operated, forty-one were cured, and in thirty-one the results were fair.

Lewisohn stated about one year ago that in thirty-three patients reporting to the return clinic at the Mt Sinai Hospital for examination, twenty had been perfectly well and free of any gastric symptoms since the suture of the perforation, ten cases had been treated with simple suture of the perforation, and in the other ten cases a gastro-enterostomy had been performed. However, thirteen cases (ten treated by suture and three by suture plus gastro-enterostomy) were not feeling well. Subsequently four of this last group were re-operated and he therefore concluded that simple suture of the perforation with or without gastro-enterostomy does not cure the patient in 39 per cent of the cases.

We were able to re-examine twenty-two of our perforated ulcers which had been treated by simple sutures, five required re-operation because of pyloric stenosis, one was suffering from pyloric stenosis before operation and another patient was subjected to a partial gastrectomy on account of the return of primary gastric symptoms, and a fifth one on account of intestinal obstruction. Unfortunately the last patient died in our clinic, but the others remained well after the second operation. A sixth patient sixty-three years of age

operated for an acute perforated ulcer on the lesser curvature, three years later developed an acute pancreatitis which responded well to a second operation. In this celiotomy we did not find any evidence of the ulcer which had been sutured. The patient continued in perfect health after the second operation and was not heard from. Three other patients are suffering from epigastric distress and pains occurring after eating. Finally, there are two more who assure us they are feeling much better than before the perforation took place, but nevertheless from time to time they are obliged to take bicarbonate of soda or some other anacid. Eleven of the patients are perfectly well. Our late results have been satisfactory in fourteen cases, that is 63.6 per cent, and bad in 36.3 per cent. Four of these cases were operated later with good results.

Our results are almost analogous to those observed by Lewisohn. In our series, simple suture proved much better than when combined with gastroenterostomy. We have had the opportunity to study seven patients who had been operated upon for an acute perforated ulcer treated by simple suture by other surgeons. They consulted me because of recurrent symptoms. Three of these patients were relieved by subsequent medical treatment. Four others were re-operated. A summary of their histories is as follows:

CASE I—L. R., from Santander, thirty-three years old. His gastric complaints date back for eight years. Exploratory laparotomy in Albany, N. Y., in 1918. The suspected ulcer was not found. Three years ago, he had an acute perforation while in Bluefield, W. Va. suture of perforation. After three months, recurrence of gastric symptoms and tarry stools. Gastric residue free hydrochloric acid 38, total acidity, 52. X-ray examination showed hyperperistalsis and deformity of the duodenal cap. Re-operation August 8, 1925, cicatrix on anterior wall of the duodenum and ulcer of the posterior wall, adherent to the pancreas. Partial gastrectomy and gastro-jejunostomy (Reichel-Polya). Discharged after two weeks.

CASE II—J. P. S., thirty-six years old, gastric symptoms for five years. Acute perforation with suture two years ago. Recurrence of symptoms since six months. Operation February 10, 1928, partial gastrectomy and gastro-jejunostomy (Moynihan) for pyloric ulcer. Specimen showed a callus ulcer about two-thirds of an inch in diameter. Excellent post-operative course. Nine months afterward the patient feels perfectly well, having gained six kilos.

CASE III—N. A., thirty-five years old, intermittent gastric symptoms for eight years. June, 1927, first perforation suture, February 1928, second perforation suture. Gastric symptoms continued. A few days before he consulted me, he had a large black stool. Test meal free hydrochloric acid 80, total acidity 102. X-ray examination shows a persistent deformity of the duodenal cap. Operation April 13, 1928, partial gastrectomy with antecolic gastro-jejunostomy (Moynihan). Specimen showed a callus ulcer of the anterior wall of duodenum and two silk threads of different calibre, corresponding to the two sutures made previously by another surgeon. Discharged cured after two weeks. February, 1929, patient perfectly well.

CASE IV—P. D. A., fifty-two years old. Gastric symptoms for nine years. Seven years ago acute perforation. Excision of ulcer and suture of the perforation. Relief from symptoms for five years. Chronic perforation with perinephritic abscess, January, 1928. Drainage of abscess. Recurrence of symptoms, accompanied by melaena. I saw the patient on August 20, 1928. He is exceedingly pale (hemoglobin 50) and very feeble. Intensive reactions of blood in stools. August 20, 1928. X-ray examination showed a large niche of irregular contour at the re-entrant angle. Operation, August 25, partial gastrectomy

LATE RESULTS IN PERFORATED GASTRODUODENAL ULCERS

and gastro-jejunostomy (Moynihan) The patient died three days after the operation
Microscopic examination carcinoma

Summary—The clinical material upon which this paper is based may be divided into three groups (1) fifty-two acute perforations operated on in a private clinic, (2) seven acute perforations operated by other surgeons four of which I re-operated, and (3) eighteen personal cases of subacute perforations

Study of these seventy-seven cases leads to the following conclusions

CONCLUSIONS

(1) In cases of acute duodenal and gastric perforation, a simple suture covers the "vital indication" with the minimum of risk besides effecting an absolute cure of the ulcer in at least 50 per cent of the cases,

(2) In the other 50 per cent, the ulcers continue in their active stage until a new perforation or malignant degeneration occurs. Therefore, if the symptoms persist the patient should be subjected to a partial gastrectomy, or gastro-enterostomy. The latter procedure is recommended in cases of healed pyloric or duodenal ulcer with stenosis,

(3) Primary gastro-enterostomy with suture of the perforation exposes the patient to the risks of a marginal or jejunal ulcer,

(4) Partial primary gastrectomy is indicated only in cases of subacute perforation,

(5) We can hardly agree with those who consider the radical operation the proper method for the cure of jejunal perforations. However, we prefer a simple closure of the perforation and sometimes a subsequent partial or subtotal gastrectomy with jejunal resection. We have employed this method in one case of acute jejunal perforation. The patient is perfectly well ten years after the third operation (subtotal gastrectomy)

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RESECTION OF THE PROXIMAL DUODENUM AND PYLORIC SPHINCTER FOR MULTIPLE DUODENAL ULCERS

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OF PORTLAND, OREGON

FROM THE PORTLAND CLINIC

ON JULY 7, 1924, during the performance of a Finney pyloroplasty for duodenal ulcer, a large, indurated posterior ulcer was found in addition to the calloused ulcer upon the anterior wall. It seemed futile to remove one ulcer only to leave another, and for this reason the duodenum was completely divided and about an inch and a half of the proximal end resected. This procedure removed both the anterior and posterior ulcers. In order to insure patency of the pyloric opening, about an inch of the stomach, including the entire pyloric ring, was removed with the ulcer-bearing duodenum. An end-to-end anastomosis completed the operation. This patient, a nurse twenty-seven years of age, made an uneventful recovery and has had no further abdominal distress to date.

It was not until 1927 that we made extensive use of the pyloroplasty and consequently did not again have occasion to perform a similar resection of the duodenum until then. Beginning in 1927, whenever a suitable case was found, the method of pyloroplasty as described by Judd, was used in preference to any other type of resection for duodenal ulcer. When a single ulcer upon the anterior wall of the duodenum is encountered, the Judd pyloroplasty is ideal. All of our cases have made smooth recoveries and are, so far as we have been able to ascertain, cured. As our experience with the operation increased, however, we were forcibly impressed by the large number of multiple duodenal ulcers encountered. Judd¹ has reported the finding of multiple ulcers in but 0.71 per cent of 4901 cases of duodenal ulcer in which operation was performed. These figures are based upon work at the Mayo Clinic between January 1, 1906, and January 1, 1921, or during a period in which little plastic surgery upon the duodenum was done. Consequently a view of the lumen of the duodenum was not obtained in the great majority of these cases and undoubtedly a large number of posterior ulcers were missed. Fluoroscopy is unreliable in the diagnosis of multiple lesions, and negative roentgenological findings do not rule them out. Indeed shallow posterior lesions by themselves may not give even the cap deformity, upon which the diagnosis of ulcer is most often made. The point we are trying to emphasize is simply that in all probability 0.71 per cent is much too low for the actual occurrence of multiple lesions. In our own cases though few in number when compared to these, two or more ulcers were found in a much higher percentage.

Of the fifty consecutive cases brought to the surgery for ulcer (gastric ulcer omitted) in 1927 and 1928 the operations performed were as follows:

Gastro-enterostomy	32- 64
Simple closure of acute perforation	2- 4
Polya resection for gastrojejunal ulcer	2- 4
Judd pyloroplasty	10- 20
Partial duodenectomy	4- 8
	<hr/>
Total	50-100

In thirty-six cases the duodenum was not opened and but one ulcer was diagnosed. In the fourteen cases in which a view of the lumen was obtained, on the other hand, contact ulcers on the posterior wall were found in seven cases, or in 50 per cent. In two cases many lesions were present, five distinct ulcers in one case, and four in another (Fig 1)

Posterior lesions in the first four cases were disregarded, the anterior

ulcer being removed with a section of the pyloric ring in the manner described by Judd. These patients did not do as well as usual. One case especially had persistent distress for months following the operation and even today any slight indiscretion in diet will bring about a recurrence of pain.

Because of this unsatisfactory experience we determined to disregard posterior ulcers no



FIG 1—Section of proximal end of duodenum and pyloric ring removed by partial duodenectomy. Arrows point to the five indurated ulcers found in this specimen.

longer. A complete resection of the proximal end of the first portion of the duodenum, including the ulcerative lesions, and the pyloric ring of the stomach with end-to-end anastomosis is now done when possible in all cases of multiple duodenal ulcers (Figs 2, 3, 4). This operation has been performed by us five times with complete and permanent cure in every case except one. Convalescence is smooth and the post-operative reaction slight compared with gastro-enterostomy, gastric resections, and other surgical procedures for the cure of lesions of the duodenum. There is apparently no more post-operative risk or shock than in the Judd pyloroplasty.

One of our cases died on the third post-operative day following the intravenous injection of faulty glucose solution by an inexperienced intern. Until the time of this unfortunate accident the patient, a man sixty-five years of age, with four indurated ulcers in the proximal inch and a half of the duodenum, had shown splendid progress. After the first twelve hours there had been no vomiting and little discomfort. As is our custom, we had given him water in small quantities for the first time on the morning of the third day, intravenous glucose being routinely employed in stomach cases the first three days. The glucose was given at 11:30 A.M. About twenty minutes later the patient had a severe chill and became very cyanosed. He soon lost consciousness. Because of the extreme anoxemia he was placed in the pneumonia tent.

DUODENAL RESECTION FOR MULTIPLE ULCERS

and seemed to rally somewhat but expired at 7 A.M. the following morning. Autopsy revealed an ante-mortem clot in the right pulmonary artery. The anastomosis between the stomach and duodenum was in perfect condition and undoubtedly had it not been for this tragic mishap the patient would have had an excellent result.

We think this operation solves a vexing problem, and, when indicated, is indispensable. Horsley² for some years has employed his pyloroplasty when-



FIG. 2—(a) Judd pyloroplasty partially completed showing anterior and posterior ulcers. (b) Method of resecting posterior ulcer—first step of partial duodenectomy, excision of posterior ulcer and pyloric ring.

ever possible in dealing with duodenal ulcerations, and during this time has been confronted repeatedly with the question of how to deal with posterior and contact ulcers. On two occasions he attempted to resect the posterior ulcer through the pyloroplasty opening on the anterior wall. Sutures were placed in the posterior wall to draw the edges together to close the space made by removal of the ulcer and to control hæmorrhage. Because of the small opening through which this work was done he was unable to control bleeding and these two cases ultimately bled to death. This very disastrous experience compelled Horsley to abandon this method of attack on posterior ulcers.

Many writers, especially the Europeans, during the last few years are advocating extensive gastric resection for duodenal ulcer. We feel that this is not a logical treatment of this problem. In the first place partial gastric

resection in the best hands carries a mortality rate of from 6 to 10 per cent Secondly, resection of the stomach as ordinarily performed does not remove the duodenal lesions, but even if, as has been recently advocated, a portion of the proximal duodenum is removed in a partial gastrectomy, we maintain this method as a primary operation to be unnecessarily extensive Lastly, gastrojejunal ulceration, when it does develop following pylorotomy, is a far more appalling condition with which to deal than a recurrence of a

duodenal ulcer after resection of an inch or two of the duodenum

There is no question in our minds as to the preferability of pyloroplasty to gastro-enterostomy in selected cases Pyloroplasty in our experience is less dangerous, is followed by fewer recurrences, and the immediate post-operative reaction is infinitely milder From the literature it is impossible to accurately estimate the percentage of recurrences to be expected following pyloro-

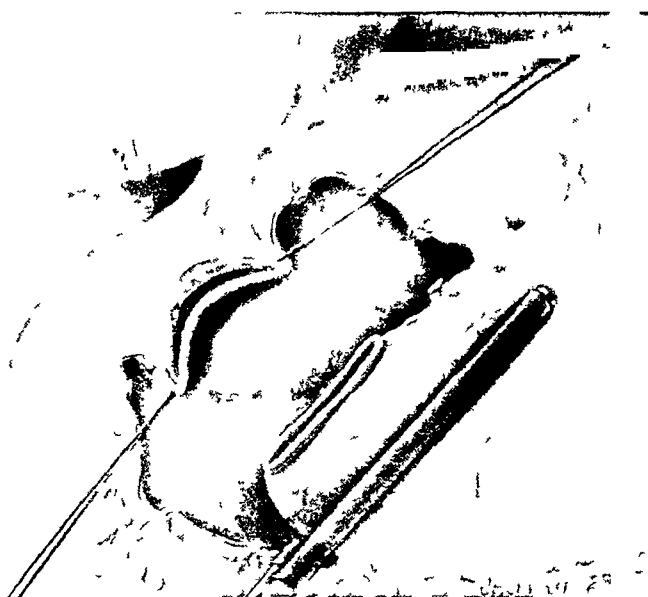


FIG 3—Second step of partial duodenectomy. Note that the semicircular incision widens the duodenum sufficiently to permit direct anastomosis to the stomach

plasty Reports by well-known surgeons vary from 2 to 13 per cent^{3 4} When present, recurrences after pyloroplasty may still be conservatively treated with a gastro-enterostomy but gastrojejunal ulcer usually must be dealt with by extensive gastric resection

Gastro-enterostomy may be followed by other serious complications The vicious circle dreaded since the first gastro-enterostomy by Wolfier, in 1881, is even today not a thing of the past Occasionally, in spite of correct operative technic and painstaking care, the distal loop will become kinked and regurgitant vomiting will ensue, necessitating entero-enterostomy

The adverse views which R Lewisohn⁵ of Mount Sinai expressed as to this operation by his report of 34 per cent of gastrojejunal ulcers has failed in its apparent intent to frighten surgeons from gastro-enterostomy entirely Indeed, many papers written since by no less authorities than Balfour,⁶ Judd,¹ Moynihan,⁷ and other master surgeons expressly refute Lewisohn's statistics Nearly all are willing to admit, however, that gastrojejunal ulcer is of more frequent occurrence than the heretofore accepted 2 per cent In the large clinics where the operation is performed by expert surgeons under the most favorable circumstances, gastrojejunal ulcers occur in 3 to 5 per cent of the reported cases Throughout the

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country this percentage is undoubtedly much higher. Possibly the conservative estimate of Davis⁵ (approximately 8 per cent) is more nearly correct than the prohibitive figure of Lewisohn. At all events, gastrojejunal ulcer occurs with sufficient frequency and creates, when present, such a difficult problem, that for the avoidance of this complication alone surgeons will gladly accept any practical substitute for gastro-enterostomy.

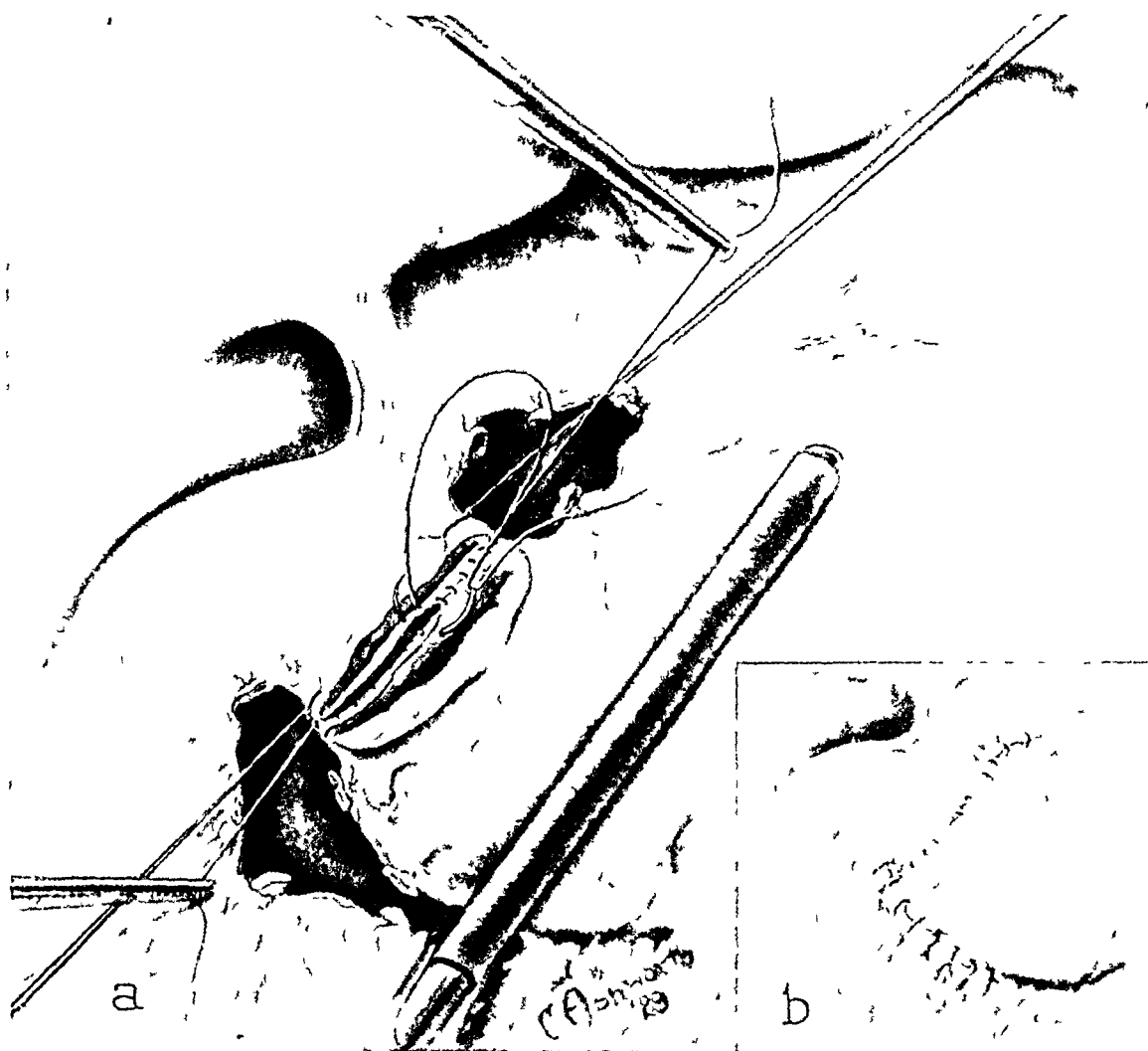


FIG. 4—(a) Method of anastomosis. Three layers of sutures were used. (b) Operation completed.

As is readily seen, all these points favor pyloroplasty and operators in this country, following the leadership of Finney,⁹ Judd,¹ Horsley,² and others, are using this operation instead of gastro-enterostomy whenever possible. This is as it should be. We use the plastic operation for nearly every duodenal ulcer in which the duodenum is sufficiently loose to permit suture without tension. Where multiple or posterior ulcers are found, the entire ulcer-bearing area, usually the first inch of the duodenum and the pyloric sphincter, is resected. Any duodenum mobile enough to permit easy pyloroplasty can be resected in this manner without great difficulty. Gastro-enterostomy is still preferred for old stenosing ulcers, for ulcers acutely inflamed where the associated edema

of the duodenum would make suturing unsafe, and for ulcers occurring in a relatively immobile duodenum

Judd,¹ in writing upon the treatment of duodenal ulcers, makes the following statements "Gastro-enterostomy results in healing, although not in every case I do not believe the present wave of enthusiasm for resecting the stomach for duodenal ulcer will last very long The best type of operation for duodenal ulcer is one that removes the ulcer and places the pyloric sphincter at rest"

When posterior ulcers are absent, the Judd pyloroplasty fulfills these re-

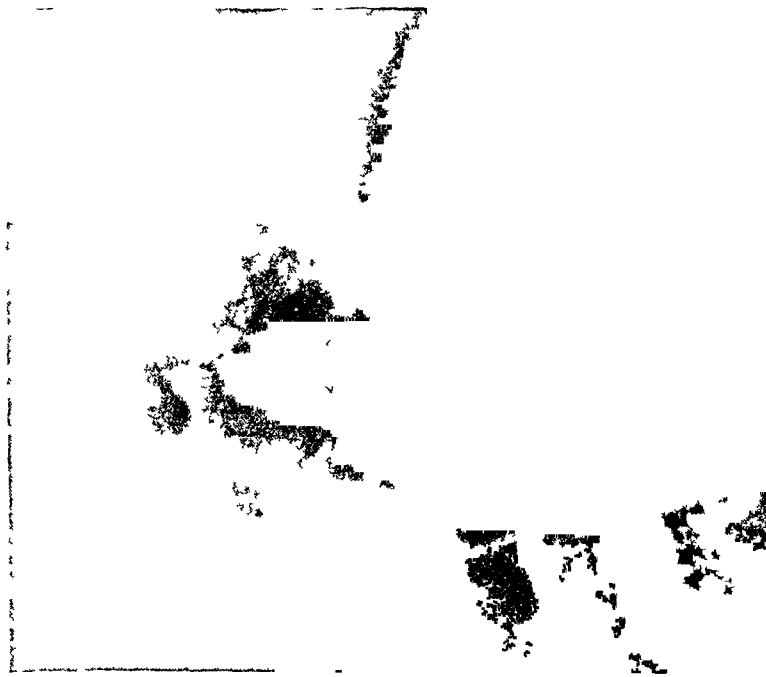


FIG 5—Roentgenogram of stomach and duodenum prior to operation Note the poorly filled, deformed duodenal cap

quirements, when present however, a partial duodenectomy, as described must be done to satisfy these demands

What the ultimate outcome of this operation will be we cannot now state We have only four cases that have been observed long enough to warrant the drawing of conclusions The first case we did, four and a half years ago, as has been stated, re-

mains well to date Rescreening these cases after a period of years reveals a practically normal condition (Fig 7) The chief difference from the unoperated patient is the absence of the characteristic duodenal cap (Fig 5) In spite of the complete removal of the pyloric sphincter by the operation, roentgenologically a mild sphincteric action is still observed (Fig 6) Possibly the circular muscle fibres in this region may develop after a time into a true sphincter after the pyloric ring has been removed Whatever the explanation of this phenomenon, spasm in every case is lacking and barium can readily be pushed from the stomach into the duodenum without force For this reason we believe that if the muscles at the end of the stomach have become somewhat sphincteric in action, this is not pronounced enough to be detrimental

We realize the scope of this operation is very limited, but it does provide a graceful exit from the embarrassing situation one faces when unsuspected contact ulcers are encountered in the course of the performance of a pyloroplasty It has, therefore, a very definite place in surgery of the duodenum, but

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in spite of this fact there is very little reference to partial duodenectomy in the literature

Balfour,^{10 11} in 1927 and again in January of this year reported a practically identical operation except that he removes rather more of the stomach than we do. His method, in which seven to eight centimetres of the stomach is removed, is essentially a Billroth No. 1, which includes the ulcer-bearing

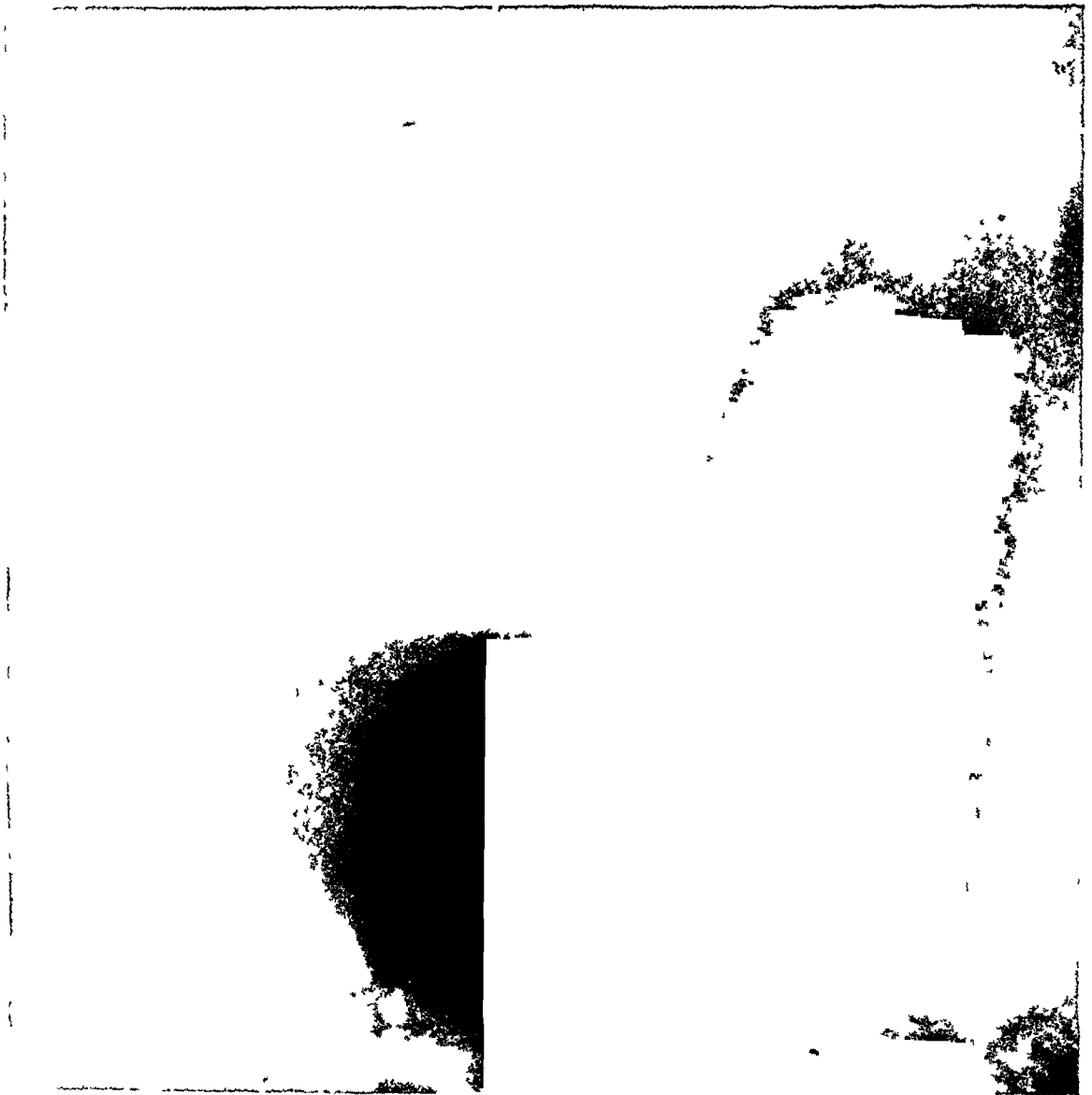


FIG. 6—Two months after partial duodenectomy. A distinct sphincteric action in pyloric region of stomach may be observed despite removal of the pyloric ring at operation. Rugae are still seen in the first portion of the duodenum although a tendency to cap formation has already become manifest.

duodenum. It is our opinion that it is unnecessary to resect the stomach where the chief lesion is duodenal except to remove the pyloric ring, and in this only does our method of resection differ from his.

Balfour recommends partial duodenectomy for multiple ulcers, calling attention to the fact that by this means the entire circumference of the duodenum is removed. He stresses the desirability of this operation in cases in

which the chief reason for surgery is repeated hæmorrhages. In the literature available to us we have found no reference to partial duodenectomy for mul-



FIG 7—Four and a half years after partial duodenectomy. A dilatation of the first portion of the duodenum simulating the normal cap is to be seen. Note relative absence of rugæ here. Sphincteric action in stomach empties without difficulty.

multiple duodenal ulcers other than the reports by Balfour. As we think it a logical and practical procedure in suitable cases, we add this report to his in an effort to interest the profession at large in this operation.

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HIGH VEIN LIGATION IN THROMBO-ANGIITIS OBLITERANS

A REPORT OF NINE CASES

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THE treatment of thrombo-angitis obliterans has been very unsatisfactory and a source of no little concern to the surgeon who so frequently has been forced by the failure of his therapeutic measures to admit defeat, and in desperation to sacrifice one or more limbs of patients suffering from this mutilating disease. Not knowing its cause we have been obliged to combat its progress in indirect ways that are popularly spoken of as conservative methods of treatment. A review of the recent literature on this subject will show many such conservative methods which it is not the purpose of this paper to discuss and evaluate but none has as yet yielded entirely satisfactory results and most of them have resulted in disappointment. These facts should not discourage us, however, from further trial of conservative measures, for despite occasional failure, they are gradually superseding high amputation in the treatment of this dreaded disease. Most surgeons who come into frequent contact with thrombo-angitis obliterans will agree, I feel sure, that the day of high amputation as the operation of choice in this disease has passed. But we are still groping about in the dark in our search for the best form of conservative treatment, and until we are able to eradicate this disease by striking at its cause, we must go on searching for the surest method of treatment that will give relief of all symptoms in the shortest possible time.

It is interesting to observe that each new procedure that has been mentioned in the literature as a possible therapeutic measure has sooner or later fallen under condemnation until there is not one that is generally accepted as of distinct merit. Although this is true in respect to individual methods of treatment, there is, however, an underlying principle that is becoming more and more universally accepted by all surgeons, namely, the importance in this disease of the development of the collateral circulation. Meleney and Miller¹ stressed this point, and showed definitely that a favorable outcome of the disease was dependent upon the production of an adequate collateral circulation. Later, Lewis and Reichert² emphasized this same fact and at the present time, most writers agree that in cases of thrombo-angitis obliterans the collateral circulation is the most promising key to the solution of the prevention of gangrene.

Following the recognition of this fact a great deal of experimental work has recently been carried out to ascertain the best methods of assisting nature in producing as large a collateral circulation as possible. One of the first methods tried was that of reversal of the circulation by the production of an arteriovenous anastomosis. Reid³ and his associates have shown that such

a condition gives rise to a marked increase in the collateral circulation of an extremity, but attempts to apply this principle in the therapy of human circulatory diseases have not been successful so far, as shown by the experiences of Wieting,⁴ Lilienthal,⁷ and Horsley.⁶ The last named author came to the following conclusion in regard to this procedure "In impending gangrene due to organic disease of the artery of any kind, reversal of the circulation, *i e*, artificial arteriovenous anastomosis, appears unjustifiable. It seems, however, that such cases may be materially benefited by merely ligating the femoral vein. This would tend to balance the circulation by obstructing the venous circulation and permitting the arterial blood in the capillaries to bathe the tissues a longer time than would be the case if the venous circulation were unobstructed. The operation, then, of ligating the femoral vein in threatened gangrene in the lower limb due to partial occlusion of the arteries appears to have a proper field. The resulting improvement should be as great as after any kind of arteriovenous anastomosis, and the operation is much simpler and less dangerous to the patient."

This idea of vein ligation, as recommended by Horsley, had previously been employed by Oppel,⁷ who in 1913 published favorable results from popliteal vein ligation in six cases of arteriosclerotic gangrene. Four years later, through the experimental work of Van Kende⁸ and the writings of Makins,⁹ Sehrt,¹⁰ Popping,¹¹ and Tuffier,¹² one of the great fundamental principles of blood-vessel surgery became universally recognized, namely, that when the main artery to an extremity is suddenly severed or blocked, the resulting circulation of the limb will be greatly improved, and gangrene often prevented by the simultaneous ligation of the companion vein. It was also recognized at this time that the more proximal the occlusion of the artery the less likelihood of gangrene, because of the increased opportunity for the formation of a collateral circulation in the extremity. These great clinical observations have been sufficient in themselves to insure acceptance by the medical profession, although their explanation is still a matter of some uncertainty and dispute.

Recent experimental studies on this question have shown that the procedure of ligating the main vein simultaneously with the main artery of an extremity results in, (1) an increase in the venous pressure¹³, (2) an increase in the volume flow of blood beyond the ligated artery¹⁴, (3) an increased residual arterial pressure^{8 14 15}, (4) an increase in the peripheral arterial circulatory bed,¹⁵ and (5) a decreased incidence of gangrene.^{13 14}

Applying these findings to the problem of hastening the production of a collateral circulation in thrombo-angitis obliterans, it seemed reasonable to the writer to employ this procedure of vein ligation as a therapeutic measure in these cases, even though the blood vessels of the extremity were pathological in certain areas and although the results of several previous investigators, who had ligated the femoral vein for this condition, were not striking.^{15 16} For in thrombo-angitis obliterans, we have a disease of the blood vessels in which arterial occlusion predominates. The veins, to be sure,

are also affected by the same pathological process, but their involvement is not nearly so extensive as that of the arteries, especially in the case of the great main vessels of the extremity. Thus with arterial blockage on the one hand resulting in an ischæmia, and only slight embarrassment of the venous return from the limb, a great imbalance of the circulation takes place which may be corrected by ligation of the main vein.

Vein ligation in the treatment of spontaneous gangrene has been favorably recommended by Opell,⁷ Stradin,¹⁸ Brooke,¹⁹ and Morton, but it has been the recent experimental work of Holman¹⁴ that has rendered additional stimulus to this selected form of therapy and because of it the writer was encouraged in five cases of this series to ligate the external iliac vein instead of the femoral vein.

In addition to clinical observations on the progress of the local gangrene, in the later cases of this series the intradermal salt solution test was used as an index of the degree of impairment of the circulation in the limb. This test, which was originally devised by McClure and Aldrich and later used extensively by Cohen and Stern, is based on the principle that the affinity of the tissues for water is increased in proportion to the impairment of the circulation. In other words, it was found that salt solution injected intradermally disappears more rapidly from areas with deficient circulation than from areas in which the circulation is normal. The technic of injection, as given by the originators, is as follows: "Two-tenths cubic centimetre of an 0.8 per cent aqueous solution of sodium chloride is injected intracutaneously under aseptic precautions. The needle is inserted sufficiently superficially so that the lumen is visible through the skin. The end point of the disappearance of the elevation can best be determined by palpation unassisted by inspection, since color changes seen about the point of injection may cause confusion. It is necessary to disregard the very small traumatic elevation that is occasionally produced just where the needle enters the skin. This may persist after the large elevation, due to the injected salt solution, has disappeared." The normal disappearance time for healthy individuals varies from thirty minutes in the region of the toes to fifty minutes in the region of the thigh. Should the salt solution wheal disappear before thirty minutes in the foot or before fifty minutes in the area of the thigh, the indication is that there exists an impairment in the circulation.

CASE REPORTS

CASE I—C. H. T., a Chinese farmer, twenty-four years of age, was admitted to the hospital August 21, 1925, complaining of severe pain in the arch of the right foot, and especially in the region of the first metatarsophalangeal joint, there was also a feeling of cold and numbness in the right foot and muscles of the calf. One year before, his left leg had been amputated through the thigh for the same condition from which he was now suffering. Examination showed several small dark areas along the lateral border of the right foot, but no definite gangrene. Tenderness was obtained upon palpation over the medial and dorsal portions, and the foot felt colder than normal. There was no pulsation in the dorsalis pedis or posterior tibial arteries, and palpation of the popliteal artery

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revealed no impulse. Pulsation of the femoral artery could be felt for a distance of only three centimetres beyond Poupart's ligament.

Operation—August 24, 1925. Excision of a portion of the right femoral artery and right femoral and saphenous veins for thrombo-angitis obliterans.

Procedure—An incision over the course of the femoral artery was made at the apex of Scarpa's triangle. The vessels were exposed and found to be tightly bound up in inflammatory tissue. The artery was finally dissected free and found to be completely obliterated. Since it seemed useless to attempt a periarterial sympathectomy, the operator excised a segment of the artery and the vein together with the surrounding inflammatory tissue in order to completely interrupt all of the sympathetic nerve fibres. The saphenous vein was also ligated, and the wound was closed with interrupted fine silk sutures.

Post-operative Course—The operative wound healed *per primam*. Pain was definitely relieved but did not disappear. The pathological report stated that there was a complete obliteration of the lumen of the artery. A diagnosis of thrombo-angitis obliterans was made. The patient was discharged to his home, September 8, 1925.

Readmission—The patient returned to the hospital one month later (October 3, 1925) showing beginning gangrene of his second right toe. The previous excision of a portion of his femoral artery and vein had apparently not benefited him. Advancing gangrene and continued discomfort had led him again to desire amputation for relief.

Second Operation—October 6, 1925. Amputation of the right lower leg (middle third). This procedure was carried out under spinal anaesthesia and without the use of a tourniquet. The stump failed to heal readily and was so painful that another amputation at a higher level was advised.

Third Operation—October 15, 1925. Amputation through lower thigh.

Post-operative Course—Pain disappeared following the second amputation and the stump healed by first intention. The patient was discharged to his home on November 3, 1925.

Comment—From the therapeutic point of view this case was a distinct failure. High ligation of the right femoral vein, saphenous vein, and the obliterated femoral artery failed to stop the advancing gangrene, and only partially relieved the patient's pain, so that amputation through the mid thigh was finally necessary. With the femoral artery in this case already completely obliterated at Scarpa's triangle, a not uncommon finding in this disease, we might consider that nature had already performed a high ligation of the artery, thus establishing the condition which Lewis²⁴ and Theis²⁵ advocated in the treatment of thrombo-angitis obliterans. In spite of the benefit that might have arisen from this, however, gangrene had continued to advance accompanied by extreme pain, for the relief of which the obliterated femoral artery was sectioned in the hope that by completely breaking the continuity of the sympathetic nerve fibres accompanying this vessel and thus placing the main artery at rest, the patient's pain would be relieved. At the same time the right femoral and saphenous veins were doubly ligated to balance the circulation of the limb.

All of these measures were attended by no improvement except a transient relief of pain. It is a question whether ligation of both the femoral and saphenous veins produced too great a stasis of blood, for in other cases of this series favorable results both in the relief of pain and in improvement of the gangrenous condition were obtained by high ligation of the femoral vein alone.

CASE II—C F C, a Chinese fortune teller, sixty-one years of age, was admitted to the hospital December 13, 1927, for the third time. On the two previous admissions he had had amputations of his left toes and left thigh for thrombo-angitis obliterans. Since his last discharge from the hospital three years ago, he had been fairly free from pain in the extremities for two years, but about eight months before readmission, the old symptoms had begun to return, pain starting at the shoulders and radiating to his finger tips and starting in the right thigh and radiating to the toes of the right foot. For the past two months this pain in his leg had been unbearable and he had resorted to morphine for relief.

Physical examination at this time showed an ulcer over the right small toe. The tips of the middle and big toes of the right foot had been ulcerated and gangrenous but had healed leaving the toes a little short. There was an ulcer involving the side of the right thumb and the base of the nail. The nails of all the fingers and toes were atrophied. The tip of the left index finger had ulcerated away, shortening the finger a little. The right foot was cold and slightly swollen.

Examination previous to operation showed no pulsation of the arteries in the entire right lower leg. The right femoral artery, however, could be felt to pulsate fairly strongly, the right radial artery could not be felt. In view of the fact that the patient had already had his left leg amputated for this same disease, it was felt that every possible effort should be made to save the right foot which was already gangrenous and infected in the region of the little toe. Following Holman's idea¹³ of the ligation of the corresponding vein of a limb proximal to the blockage of the artery, it was thought advisable to ligate the right femoral vein in this case.

Operation—December 20, 1927. Ligation of the right femoral vein for thrombo-angitis obliterans.

Procedure—Under local anaesthesia, a linear incision was made over the course of the femoral vessels in Scarpa's triangle. Characteristic adhesions were present at the site of exposure indicating that an inflammatory process was going on even at that high level. The artery seemed to be of normal size but its walls felt thickened and its pulsation was not as strong as normal. Between it and the femoral vein were some fairly dense adhesions which had to be cut in order to isolate the vein for ligation. The femoral vein was doubly ligated with medium silk, after which the wound was closed carefully in layers.

Post-operative Course—The pain was definitely relieved following ligation of the femoral vein. The ulcerated areas of the toes slowly improved and in three months' time were completely healed.

Follow-up—The patient was last seen on January 10, 1929, eleven months after ligation of the right femoral vein. There was no longer any gangrene and his wounds had remained completely healed since his discharge from the hospital eight months before. He walked with the aid of crutches and with only occasional slight discomfort in his second toe. Otherwise, there was no pain at all in the right foot or lower leg. In the upper extremities, the right radial pulse could not be felt, but the left one, which previously had been imperceptible, was faintly obtained.

Comment—This case is the only one of this series that showed all of the extremities affected by the disease. Fortunately the formation of a collateral circulation had taken place in both arms to combat the impending gangrene, and the patient in the course of over ten years had lost only a small portion of several finger tips. According to the patient's story the right radial pulse had been absent since the first attack of brachial pain almost twenty years ago, and recent examination confirmed its absence. On the left side, however, it is of interest to note that a faint pulsation which was not present five years before, could now be obtained in the left radial artery indicating that canal-

ization of a thrombus may have taken place or that blood had again found its way into this vessel at a point distal to the original blockade

The lower extremities in this case failed to share the happier fortune of the upper ones, for advancing gangrene and extreme pain had driven the patient to beg for amputation of the left leg, which was performed three years ago through the mid thigh

When the disease process later spread to the patient's right leg, and gangrene of his small toe became quite marked, ligation of the right femoral vein relieved his pain at once and furthered the healing of the wound so that it completely healed in three months' time, and remained so for almost a year. He now walks with this remaining foot and the aid of crutches with but slight discomfort

It is interesting to speculate in retrospect as to whether or not a ligation of his left femoral or external iliac vein might have postponed the amputation or permitted it safely at a lower level of the limb, but vein ligation for this disease had not then been tried in our clinic and other conservative measures were of no avail. We can now say with some assurance that ligation of the vein would have relieved his pain and afforded at least temporary improvement of the local gangrene

There is little question in my mind that ligation of the right femoral vein had a salutary effect in combating the advancing disease process and was in fact the means of preserving the patient's right lower extremity. Whether or not the result will be permanent is open to doubt, but in my experience with many cases of thrombo-angitis obliterans among the Chinese, the procedure of high vein ligation has given the quickest and most hopeful results of all the conservative therapeutic methods now employed

CASE III—K Y C, a Chinese peddler, twenty-five years of age, was admitted to the hospital January 17, 1928. Eight months earlier, in this hospital, his left leg had been amputated at the upper thigh level for thrombo-angitis obliterans, but the stump had refused to heal. Because of the persistent ulceration, associated with pain, it was thought that ligation of the external iliac vein might improve the circulation and thus hasten the healing process

Physical examination showed a well-built young man with a high left thigh amputation stump ulcerated at its end. The ulcer was about the size of a quarter, looked indolent, and was slightly excavated. No definite pulsation of the left femoral artery could be felt, although at times there was a suggestion of pulsation. The vessels of the right leg appeared to be normal. Laboratory examination showed urine, blood and faeces to be normal, and a negative Wassermann reaction

Operation—January 20, 1928. Ligation of the left external iliac vein for thrombo-angitis obliterans

Procedure—An incision four inches long was made just above the middle of Poupart's ligament on the left side, and carried down through the muscle layers exposing the peritoneum which was reflected upward. The vein was found to be uninvolved in the thrombotic process, but it was stuck tightly to the external iliac artery, and an attempt to separate it from the artery tore it and produced a brisk hæmorrhage which was, however, controlled with little difficulty. The external iliac vein was ligated in two places with heavy silk sutures. The external iliac artery was very small and cord-like and its pulsation was very feeble. Following ligation, pulsation of the vessel could not be seen

at the proximal ligature. It was questioned whether the artery also had by accident been included. The wound was closed in layers with interrupted sutures of fine silk.

Post-operative Course—The operative wound healed by first intention. The ulcerated area remained practically stationary for several days and then showed signs of slow improvement. The patient was discharged from the Out-Patient Department March 10, 1928, at which time the ulcer measured only a few centimetres in diameter, but was not definitely healed.

Follow-up—In January, 1929, one year after ligation, the patient wrote as follows concerning his condition: "I still have slight pain in my leg stump but not nearly so much as before operation. The ulcer is not yet healed, although it also is better than it was before operation."

Comment—Amputation through the mid thigh was not sufficiently high to allow perfect wound healing in this case, and reamputation may eventually be necessary to accomplish this end. The condition of the external iliac artery as seen at operation could easily account for the failure of healing on the basis of scanty arterial blood supply. On the other hand, the external iliac vein, being patent, was emptying the limb of its blood without restriction, thus producing an imbalance of the circulation. It was hoped that ligation of the vein would, by impeding the outflow of blood, tend to equalize the arterial and venous circulations and afford a better blood supply for the healing area. This desired result has so far not been accomplished, for after a period of one year we find the ulcer, although improved, still unhealed. In this case, then, we can say that high vein ligation greatly relieved the patient's pain and slightly improved the gangrenous condition, but has failed so far to secure wound healing.

CASE IV—C C, a Chinese street hawker, forty-four years of age, was admitted to the hospital October 28, 1927, with a history of intermittent pain of twelve years' duration in his left great toe. Associated with this was a history of occasional limping, especially in prolonged walking, and of cramps in the left lower leg. These were very severe at night. The left foot had been hypersensitive to cold for the past six years, so that during sleep the patient was obliged to wrap it in extra bed clothes. Last winter an ulcer formed as a complication of an infection of a nail, and refused to heal, in spite of complete removal of the toe nail together with a small loose piece of bone. The patient was a rather heavy smoker, but took neither alcohol nor opium.

Physical Examination—The general physical examination was not remarkable. Locally, the left lower extremity showed a purple discoloration of the great toe, absence of its nail, a trophic ulcer of the nail bed, slight decrease in the temperature of the limb, and an absence of palpable pulsation in the left dorsalis pedis, posterior tibial, and femoral arteries. The muscles of the calf of this leg also showed some wasting. Upon application of the sphgmomanometer to the left thigh, slight pulsation could be observed in the column of mercury, but no pulsation in the lower leg.

An intradermal salt solution test showed rapid absorption of the skin wheal in the left lower leg, as compared with the controls on the right leg.

Laboratory findings showed urine and blood to be normal. Stools contained ascaris ova. The Wassermann reaction was negative.

First Operation—November 4, 1927. Ligation of the left external iliac vein for thrombo-angitis obliterans.

Procedure—An incision was made just above the middle of Poupert's ligament and parallel to it and carried down to the peritoneum, splitting the fibres of the external oblique muscle and dividing the internal oblique and transversalis muscles at their lower

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edge The spermatic cord was seen and displaced medially and the peritoneum gently reflected upward This gave a good exposure of the external iliac vessels, and showed the artery to be a fibrosed cord-like structure and the vein to be distinctly larger than normal Palpation of the artery revealed no pulsation and not until the operator's finger ascended to the bifurcation of the left common iliac artery could pulsation be felt At this point the internal iliac and the common iliac arteries could be felt to pulsate The main block existed therefore at the very beginning of the external iliac artery To balance the circulation, the external iliac vein was doubly ligated with medium silk just distal to the main bifurcation, and immediately following ligation, that portion of the vein distal to the point of constriction, became greatly and almost alarmingly distended At the same time, the left leg was examined by an assistant and showed a very striking picture It was mottled everywhere with small dark blue and white patches, which, upon gentle stroking with the hand, seemed to fuse and then disappear, leaving the color of the limb slightly cyanotic It was apparent that a great disturbance in the circulation of the leg was going on, especially in the area distal to the knee The temperature of the foot remained satisfactory and at no time became cold In fact the left leg felt somewhat warmer than it did before operation and was about the same temperature as the right

Post-operative Course—Following operation there was considerable swelling of the left leg, its circumference measuring four centimetres more than that of the right Pain was also present and was not relieved either by elevation or by posture The toe, in contrast, appeared less swollen than before ligation of the vein and its color returned to normal On the tenth day after the operation, however, pain recurred in the toe and it was noted that there had been a definite ascent of the line of demarcation of the gangrene Because of the increase of pain, it was thought that a ligation of the obliterated femoral artery might perhaps relieve the inflammatory process in the big vessel and thus give the patient some relief from the symptoms The following operation was therefore carried out

Second Operation—November 28, 1927 Ligation and section of the left femoral artery

Procedure—Under local anæsthesia, the femoral vein, artery and nerve were identified at the apex of Scarpa's triangle, the two former being so tightly matted together that it was almost impossible to separate them By careful, sharp dissection the artery was separated from the vein It appeared very hard and cord-like, gave no pulsation, and its lumen seemed to have been entirely obliterated Silk ligatures were tied at the upper and lower portions of the mobilized vessel, and a section of it, one and a half inches long, was removed for pathologic examination The femoral vein was definitely dilated and was much larger than normal, this being probably due to the previous ligation of the external iliac vein The wound was closed in layers by means of interrupted sutures of fine silk

Post-Operative Course—After operation, pain was temporarily relieved and the swelling of the left calf subsided The operative wound healed *per primam* Pathologic section of the vessel removed at operation showed the intima greatly thickened due to organization of a thrombus Five days after operation, pain in the toe again recurred and it was decided to amputate it The stump healed by first intention and the pain was greatly diminished The patient was discharged from the hospital December 23, 1927

Follow-up—The patient was last seen on January 5, 1929, one year after operation, at which time a small ulcer persisted at the head of the first metatarsal bone of the left foot The remaining toes of this foot showed a bright reddish discoloration and the patient said that they felt numb The affected foot was not so warm as the other There was no pain in the ulcerated area, however, either at rest or upon walking, but the calf muscles of the left leg experienced cramp-like pains on long standing or prolonged walking Sleep was no longer interrupted by pain, and the patient was again carrying on his trade as a street hawker

Comment—This is the second case of this series, in which vein ligation

(in this instance, the external iliac) did not relieve the patient's pain. It is interesting to note that excision of a portion of the obliterated femoral artery produced only temporary relief which lasted for five days and that it was not until the gangrenous toe was amputated that pain definitely disappeared. The case is of interest also because of the marked disturbance in circulation that followed ligation of the external iliac vein. Aside from the immediate reaction, however, nothing unusual was noted in the course of convalescence, and the ligation and section of the femoral artery could have had little or no effect upon the circulation of the limb, since that vessel was practically obliterated by thrombus formation at the site of operation.

Although the immediate result in this case appeared to be somewhat disappointing, we find the patient one year later walking with his foot, carrying on his work, and free from pain, in spite of the presence of a small unhealed ulcer.

CASE V—L M, a Chinese farmer, forty years of age, was admitted to the hospital May 16, 1926, complaining of pain and swelling of the left great toe. His trouble started two years earlier, when after a long walk of thirteen miles, he experienced great pain in this same toe. From that time on, long distance walking always precipitated pain which at times became almost unbearable and necessitated rest. One year before, the nail of this toe became infected and discoloration appeared as well as discharge of yellow fluid. The condition had grown progressively worse and of late it had confined the patient to his bed. The patient smoked and drank moderately.

Physical Examination—The general physical examination showed nothing remarkable. Locally, the nail area of the left great toe showed ulceration with considerable exudate from the nail bed. The dorsalis pedis and posterior tibial pulses of both feet were not palpable. Sensation over the foot was normal.

Examination of the urine and blood showed no abnormal findings. Stool examination showed the presence of ascaris ova.

A diagnosis of thrombo-angitis obliterans was made.

Operation—June 25, 1928. Ligation of the left external iliac vein for thrombo-angitis obliterans.

Procedure—An oblique incision three inches long and just above the middle of Poupart's ligament was carried down through the muscle layers to the peritoneum which was not opened but was retracted upward exposing the external iliac vessels. The external iliac vein appeared to be considerably distended and the external iliac artery was patent and pulsating normally. Between the vein and artery were some adhesions which made a separation of the two vessels rather difficult. These adhesions were of the type characteristic of thrombo-angitis, and it was only with the greatest care that the vein was separated from the artery without injury and doubly ligated with strands of heavy silk.

Following ligation, that portion of the vein distal to the ligature became greatly swollen and the operated leg was a little cooler than the other. There was, however, no marked disturbance of the circulation until half an hour later when the affected leg became cyanotic and its temperature became lower than that of the other leg. By elevating the leg and applying heat, the circulation was restored to normal and when the patient recovered from ether both limbs were the same color and temperature.

Post-operative Course—The operative wound healed *per primam* and the pain in the left foot disappeared. One month after operation, pain in the foot was absent when at rest, but slight pain was felt when the patient walked. The patient was discharged August 11, 1928.

Follow-up—A letter dated September 3, 1928, three months after operation, stated that the condition of the foot was improving.

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Seven months after operation the patient wrote that his wound was "dry" but his toe was a little swollen. There was slight pain, but much less than before operation.

Comment—Following Holman's¹⁴ theory of an increase in collateral circulation after proximal ligation of the vein, it was decided to ligate the external iliac vein in this case. Case IV of this series had had a similar operation performed with no untoward results. In this case the immediate circulatory reaction following ligation was not so great as in Case IV, but the patient's pain was immediately relieved. The wound of the great toe, however, did not show the distinct early improvement that was manifest in most of the other cases, but later, as shown by the follow-up report, the wound became dry and there was apparently no extension of the gangrene.

CASE VI—T A T, a Chinese farmer, twenty-nine years of age, entered the hospital July 6, 1928, with a chronic ulcer of his right foot, which had been present for several months and refused to heal. Associated with the lesion was extreme pain, which was worse at night. There was a past history of dry progressive gangrene of the second toe of the right foot and of four toes of the left foot, only two of which now remained. The gangrene of the left foot had required three years for healing. The patient smoked cigarettes occasionally.

Physical Examination—The general physical examination was negative except for the lower extremities. Three toes were missing from the left foot and one from the right. There was an unhealthy sluggish looking ulcer at the base of the right great toe. The dorsalis pedis, posterior tibial, and popliteal pulses were not palpable on either leg, but pulsation of the femoral vessels was readily made out. Blood-pressure readings could not be obtained at either popliteal space, but were equal and readily observed in the arms.

Examination of the urine and blood showed no pathologic findings. Stools showed the presence of ascaris ova. The Wassermann reaction was negative.

A diagnosis of thrombo-angitis obliterans was made.

Operation—July 11, 1928. Ligation of the right external iliac vein for thrombo-angitis obliterans.

Procedure—Under ether anaesthesia, an incision was made parallel to Poupart's ligament on the right side and about half an inch above it. This incision was carried down to the peritoneum which was then reflected upward without opening into it. The external iliac vessels were readily isolated and were found to be involved in an adhesive process characteristic of thrombo-angitis obliterans. The artery pulsated freely, but its wall was somewhat thickened. The vein appeared to be distended and was so firmly stuck to the artery that separation was difficult. Having successfully isolated a small portion of the external iliac vein, double ligatures of heavy silk were used to occlude the vessel.

The wound was closed in the usual way. There was no immediate circulatory reaction following ligation.

Post-operative Course—Following operation the pain disappeared. The operative wound healed by first intention. An intradermal salt solution test was made July 21, 1928, for record. The following table shows the findings:

Site of Injection	Absorption Time	
	Right	Left
Thigh (Upper 1/3)	62 minutes	46 minutes
Thigh (Middle 1/3)	61 minutes	63 minutes
Thigh (Lower 1/3)	52 minutes	47 minutes
Leg (Upper 1/3)	31 minutes	30 minutes
Leg (Middle 1/3)	27 minutes	33 minutes
Leg (Lower 1/3)	23 minutes	26 minutes
Dorsum of foot	12 minutes	12 minutes

July 23, a small remaining gangrenous area was removed from the right toe to encourage rapid healing. This was done under gas and oxygen anaesthesia, the distal phalanx of the right second toe being amputated. The patient was discharged to the Out-Patient Department on July 30 for further dressing of the granulating wound.

Follow-up—Two months after operation the patient's pain had not returned and symptomatically he was greatly improved. The wound of the second right toe was clean and was granulating, but had not entirely healed. Seven months after operation his wound was again examined and found to be much improved, but not yet completely healed. He had no pain in his foot except upon long walking, *i.e.*, distance of over one mile. He felt that his condition was steadily getting better.

Comment—Ligation of the external iliac vein in this case yielded immediate relief of pain and definite improvement of the gangrenous condition of the toe.

CASE VII—Y C J, a Chinese beggar, twenty-nine years of age, was admitted to the hospital July 14, 1928, with gangrenous stumps of both lower legs. Six months previously, when he had been commandeered by soldiers to act as a coolie in an army camp, he first noticed severe cutting pains in both feet, which came in attacks at irregular intervals. At the same time he had difficulty in keeping his feet warm and once, after soaking them in hot water, his toes became ulcerated and later gangrenous. The gangrene extended above his ankles and was accompanied by extreme pain. Three months later, after both feet had become black and dead, he himself removed them with a knife because of their offensive odor and an infestation with maggots. Severe pain had persisted in the stumps ever since.

Physical Examination—The general physical examination showed nothing unusual, except the condition of the lower extremities. Both feet were absent, with three inches of black necrotic bone projecting from each ulcerating stump. There was foul-smelling discharge. Both knees were held in a position of ninety degrees flexion and could not be voluntarily extended. The lower legs appeared atrophied. A very faint popliteal pulse could be obtained on both sides and the pulse in both femoral arteries could be palpated without difficulty. It appeared, from the equal pulsation of the vessels on the two sides and the symmetrical gangrene, that both legs had been affected by the disease simultaneously and to the same extent.

Examination of urine, blood, and faeces showed no abnormal findings. The Wassermann reaction was negative.

Operation—July 20, 1928. Ligation of the right femoral vein for thrombo-angitis obliterans.

Procedure—A longitudinal incision about three inches long was made over the right femoral vein in Scarpa's triangle. After the subcutaneous tissues and fascia were divided, the femoral artery was identified and was found to be pulsating well, but its wall was slightly thickened. The femoral vein was next readily identified and isolated. It was then doubly ligated with two strands of medium silk and the color of both stumps observed. Slight cyanosis of the right leg was seen to be present. The wound was closed in layers with fine silk.

Post-operative Course—Following operation the pain in the right leg at once disappeared, and the operative wound healed *per primam*. The ends of bone projecting from the stumps had been removed on the ward, leaving flat ulcerating surfaces which began to heal. Reverdin skin grafts were applied to both stumps on the eleventh day after operation, and although only three-fourths of them remained alive, they eventually covered the entire granulating areas.

Because of continued pain in the left leg and stump, it was thought advisable to ligate the vein on that side also and, on the basis of Holman's experimental work,¹³ to tie it as high as possible. The left external iliac vein was therefore selected for ligation.

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Second Operation—August 17, 1928 Ligation of the left external iliac vein for thrombo-angitis obliterans

Procedure—Under local anaesthesia an incision three and a half inches long was made parallel to Poupart's ligament and about one inch above it. This incision was carried down to the peritoneum which was reflected upward and not opened. The external iliac vessels were found without difficulty, the vein appearing distended and the artery appearing normal. The vein was separated from the artery by careful blunt dissection and although there were some sticky adhesions between the two vessels, these were not nearly as firm as those usually found in cases of thrombo-angitis obliterans. After isolating a portion of the vein, it was ligated in two places by strands of heavy silk, after which the peritoneum was allowed to fall back into place and the wound was closed.

Immediately following the ligation of the vein, the color of the left leg became somewhat cyanotic and the superficial veins could be seen to be distended. The temperature of the leg did not differ very much, however, from that of the right.

Post-operative Course—The patient's pain was relieved at once after ligation of the external iliac vein. The operative wound healed by first intention and he was discharged from the hospital August 29, 1928.

Second Admission—The patient was admitted to the hospital a second time (September 20, 1928) for reamputation of the skin-grafted stumps, of which the right still showed a small area of ulceration. Physical examination revealed no new findings. Both femoral arteries were pulsating but the popliteal pulses were barely palpable.

Third Operation—October 5, 1928 Reamputation of the stumps of both legs.

Procedure—Under spinal anaesthesia the lower ends of the tibia and fibula on both sides were removed leaving a length of bone six inches below the tubercle of each tibia. Both wounds were tightly closed without drainage.

Post-operative Course—Both stumps showed signs of a mild infection after operation, and the release of several sutures was necessary to control this condition. The wounds were completely healed after four weeks, when the patient was again discharged. The pathologic report of the specimens removed at operation was thrombo-angitis obliterans of the left anterior tibial artery and some smaller blood vessels.

Comment—Intradermal salt solution tests performed on this case are of special interest because of the fact that on the right side it was the femoral vein that was ligated while on the left it was the external iliac. If Holman's theory¹⁴ of high ligation of the vein holds good in cases of thrombo-angitis obliterans, one might expect in this case, in which the extremities appeared to be equally and symmetrically involved by the gangrenous process, a greater improvement in the collateral circulation of the left leg than in the right. The findings as shown below do not substantiate this, but indicate that the circulation was affected about equally in the two extremities. This may be due to the fact that although the two ligations were at different levels, the difference in the level did not include sufficient additional tributary vessels to warrant a fair comparison.

CASE VIII—L Y S, a Chinese farmer, twenty-nine years of age, was admitted to the hospital August 20, 1928, complaining of severe pain in his right leg and foot, and in his left arm. These symptoms dated back three years, when for a period of six months he had had intermittent attacks of throbbing pain in these extremities. One year after the onset blisters appeared on his right great toe, and a little later gangrene developed for which the distal end of the toe was amputated. Healing was slow and imperfect, but was finally complete after a number of months. On admission, the

amputated stump was hyperæsthetic and the patient was suffering extreme pain in the right foot and the left arm, which prevented both walking and sleeping His personal habits were good He was a moderate smoker

Physical Examination—The general physical examination showed nothing unusual except that the patient's mentality was somewhat below par Arterial pulsation was

Site of Injection	Absorption time in minutes								
	Right leg					Left leg			
	Before operation	Five days after operation	Five weeks after operation	Ten weeks after operation	Four months after operation	Before operation	Eleven days after operation	Six weeks after operation	Three months after operation
Leg (mid $\frac{1}{3}$)	17	52	30	15	8	15	34	27	5
Leg (upper $\frac{1}{3}$)	37	44	44	50	50	28	56	40	50
Thigh (lower $\frac{1}{2}$)	44	35	49	54	50	44	60	55	50
Thigh (upper $\frac{1}{2}$)	57	70	57	59	50	57	60	55	50

normal in all of the large vessels of the body with the exception of the left radial, the right popliteal and dorsalis pedis arteries where no pulse could be obtained The right foot was slightly bluish as compared with the left and the right great toe was missing, its stump being covered by very thin skin which was sensitive to touch

Blood-pressure readings were as follows Left cubital space 110/70, right cubital space 116/78, left popliteal space 142/90, right popliteal space 122/78

Examination of the urine, blood, and feces showed no pathologic findings The Wassermann reaction was negative

A diagnosis of thrombo-angitis obliterans was made

Operation—August 24, 1928 Ligation of the brachial and basilic veins of the left forearm and of the right femoral vein for thrombo-angitis obliterans

Procedure—Under brachial block anæsthesia the brachial vessels were identified in the upper arm and the two venæ comites of the brachial artery were isolated and tied The median nerve was seen but was not disturbed The basilic vein, located in the same area, was also ligated In the thigh, under local anæsthesia, the femoral vein was isolated in Scarpa's triangle and was tied without difficulty The brachial artery in this case appeared to be much narrowed and hardened and its accompanying veins were also small and adherent to the vessel in the way characteristic of thrombo-angitis obliterans Pulsation of the brachial artery was feeble In the leg, the femoral artery showed no marked changes although its pulsation was weaker than normal There were no definite sticky adhesions between the vein and artery at the area under observation Following ligation of the above vessels the patient's pain was at once relieved and there was no marked disturbance of circulation in the limbs operated upon

Post-operative Course—Following ligation the pain disappeared both in the arm and in the foot for one week and then returned in the sensitive stump of the right great toe, but not in the arm As the great toe was useless in its present state it was amputated one week later at the metatarsophalangeal joint Primary healing resulted, but the pain was not relieved Intradermal salt solution tests at this time (August 30, 1928) showed

Site of Injection	Absorption Time	
	Right	Left
Dorsum of foot	6 minutes (18)	45 minutes (50)
Leg, lower half	60 minutes (70)	60 minutes (55)
Back of hand	48 minutes (60)	33 minutes (44)
Arm lower half	60 minutes (60)	60 minutes (60)

(Figures in brackets represent pre-operative findings and are recorded here for comparison)

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Follow-up—Two months after operation, the pain in the patient's foot had decreased considerably. There was a slight sense of numbness in the fingers of the left hand, but no pain.

Comment—The intradermal salt solution tests made at the time of this patient's admission to the hospital showed very definitely the sites of impaired circulation (*i.e.*, the left hand and the right foot), which areas also corresponded exactly with the location of pain. The usual immediate relief of pain following vein ligation was experienced in this case both in the arm and in the leg, but for only one week, after which the pain returned. In view of the favorable results usually obtained, this fact is difficult to explain as well as the evidence of increased circulatory impairment shown by the intradermal salt solution test done six days after operation. It should be stated, however, that whatever pain the patient experienced subsequent to operation was never sufficient to deprive him of sleep, and never caused him to assume the characteristic sitting posture which patients with thrombo-angitis obliterans usually assume when they are in great pain. The fact that subsequent amputation of the offending great toe was followed by primary healing of the wound also argues favorably for an improved circulation in the extremity.

CASE IX—L K C, a Chinese merchant, thirty-four years of age, was admitted to the hospital December 10, 1928, complaining of ulceration of the right toe and pain in the right leg. This trouble had begun one year earlier with severe pain in the regions of the right thigh and calf. It was intermittent in character and was definitely associated with walking. He stated that after walking a short distance he was obliged to sit down and hold his right leg in an acutely flexed position during the attacks of pain. These attacks would occur intermittently through a period of two or three weeks at a time. Simultaneously with the onset of the pain, he noted a black area on the right small toe, which extended gradually until the toe finally dropped off, ten months previously. Five months before admission his right great toe also became gangrenous, and he entered a hospital in Honan, where, in the course of four and a half months, all of the toes of his right foot were amputated, but the wounds refused to heal. The patient used tobacco and alcohol in moderate amounts. He began to take opium four months before admission on account of the pain and at the time of admission he was taking about four grams a day.

Physical Examination—Except for the local condition, the general physical examination showed nothing remarkable. The right leg could not be extended beyond 135° and was slightly thinner than the left. The right foot showed an absence of all toes with ulcerated areas over the metatarsal heads and on the dorsum of the foot over the first metatarsal bone. The granulations were sluggish and exuded some purulent discharge.

Examination of the right leg showed no pulsation in the dorsalis pedis, posterior tibial, or popliteal arteries. Both femoral pulses were feeble. The left popliteal and the posterior tibial pulses were barely palpable. The left dorsalis pedis pulse was absent. Both radial pulses were palpable.

Blood-pressure readings were: Right cubital space 110/60, left cubital space 110/60, right popliteal space (not obtained), left popliteal space 99/44.

Laboratory findings showed urine, blood and feces to be normal, and the Wassermann reaction negative.

A diagnosis of thrombo-angitis was made.

Operation—December 14, 1928. Ligation of right femoral vein for thrombo-angitis obliterans.

Procedure—Under local anaesthesia a straight-line incision was made from Poupert's ligament distally in the line of the femoral artery. The deep fascia and the femoral

sheath were carefully dissected free. The femoral vein was isolated from its accompanying artery and doubly ligated with medium silk just above the entrance of the profunda branch. The femoral artery was small and thickened but still pulsated. The wound was closed with fine silk.

Post-operative Course—The operative wound gaped a little after removal of the sutures but remained clean. The patient had no pain after operation and the wounds of the foot improved rapidly.

Intradermal salt solution tests made before and after operation showed the following findings:

Site of injection	Absorption time in minutes					
	Right leg			Left leg		
	Before operation	Five days following operation	One month following operation	Before operation	Five days following operation	One month following operation
Thigh	50	42	40	61	48	54
Leg (upper $\frac{1}{3}$)	46	27	31	50	35	43
Leg (lower $\frac{1}{3}$)	13	5	27	19	16	31
Dorsum of foot	1	2	10	10	6	5

Comment—Pain was relieved at once and the patient's wound showed remarkable improvement following ligation of the right femoral vein. The intradermal salt solution test also indicated an improved circulation in the foot. At the time of discharge from the hospital the therapeutic result, though not a cure, was gratifying.

Summary of Findings in this Series of Cases

Case No.	Hospital number	Age	Sex	Disease duration	To bacco history	Pulsation of vessels				Vessel ligated	Relief of pain	Gangrene improved
						Femoral	Popliteal	Post tib	Dorsal pedis			
1	5585	24	male	3 years	Yes	+	o	o	o	Rt femoral vein Rt saphenous vein Rt femoral artery	No	No
2	6974	61	male	10 years	Yes	+	o	o	o	Rt femoral vein	Yes	Yes
3	16856	25	male	4 months	?	?	o	o	o	Lt ext iliac vein	Yes	Yes
4	18445	44	male	12 years	Yes	o	o	o	o	Lt ext iliac vein Lt femoral artery	No Later yes	No Later yes
5	20373	40	male	2 years	Yes	?	?	o	o	Lt ext iliac vein	Yes	No change Later yes
6	20864	29	male	3 years	Yes	+	o	o	o	Rt ext iliac vein	Yes	Yes
7	20971	29	male	6 months	Yes	Rt + Lt +	Rt + Lt +	Rt o Lt o	Rt o Lt o	Rt femoral vein Lt ext iliac vein	Yes Yes	Yes Yes
8	21349	29	male	3 years	Yes	+	o	o	o	Lt brachial vein Lt basilic vein Rt femoral vein	Yes No	Yes Yes
9	22559	36	male	1 year	Yes	+	o	o	o	Rt femoral vein	Yes	Yes

SUMMARY

Nine cases of thrombo-angitis obliterans have been reviewed, in which conservative treatment, consisting of high ligation of the main vein of the

extremity, was employed. In five of these cases the femoral vein was ligated at the apex of Scarpa's triangle, and in five cases the external iliac vein was tied just distal to the bifurcation of the common iliac. In two instances obliterated femoral arteries were sectioned, in addition to the vein ligation, in the hope of alleviating pain. In one case ligation of the left basilic and brachial veins was performed, and in one case the saphenous vein was ligated along with the femoral vein.

The results in the five cases of femoral vein ligations were definite improvement in three (*i e*, disappearance of pain and cessation of gangrene), cessation of gangrene, but slight residual pain in one, and complete failure to relieve symptoms in one.

The results obtained in the five cases having external iliac vein ligations were definite improvement in three cases (*i e*, disappearance of pain and cessation of gangrene), complete relief from pain but no change in the gangrenous condition in one case, and no immediate improvement in one case. This last mentioned case (Case IV) received no relief of pain from the vein ligation nor from the arterial section which also severed his sympathetic nerve fibres, and it was not until the tip of his gangrenous toe was removed, one week later, that he felt free from discomfort. One year after vein ligation he was still free from pain.

The results in the two cases in which section of the obliterated femoral artery was performed in addition to vein ligation, in order to relieve pain, were failures, indicating that periarterial sympathectomy may be of no avail in the treatment of this disease.

Ligation of the basilic and brachial veins in one case was successful both in relieving pain and in improving the circulation of the extremity.

The one case in which the saphenous vein was tied along with the femoral vessels (Case I) resulted in failure, and amputation was performed.

In these nine cases treated by high ligation of the vein, we find marked improvement in six, some improvement in two, and no improvement in one.

The criticism may be offered that a certain amount of local improvement might have resulted because of hospital care alone, without any specific form of therapy, but it has been our experience in the past in this clinic that there was little or no improvement in these cases until amputation was performed. If Miller and Kaufmann are right in their suggestion that ligation of the femoral vessels acts only to relieve pain and in no way tends to assist mechanically in the development of the collateral circulation, it is difficult to explain the improvement of the local gangrenous condition in this series of cases which has been in marked contrast to the improvement in cases not thus treated. It would appear therefore that if the disease process is arrested, even though temporarily, following high vein ligation, the most reasonable explanation is on the basis of an improved collateral circulation.

No attempt is made in this paper to explain the beneficial results of high ligation of the vein in thrombo-angitis obliterans other than on the basis of establishing a balance of circulation in the extremity.

We know that the arterial blood supply of a limb affected by this disease is impeded from reaching its most distal portions by patchy areas of thrombus formation, thus producing in case of extensive disease, death of the affected part due to ischæmia. This occlusion of blood vessels is much more extensive in the arteries than in the veins, as is shown by many instances of complete obliteration of the femoral artery, a condition never found, so far as I know, in the main veins of the limb. In exploring the large vessels in these cases we commonly find a diseased or obliterated main artery, surrounded by dense perivascular adhesions, but a patent and normally functioning vein. The arterial inflow of blood is diminished in proportion to the extensiveness of the thrombotic process, while the venous outflow appears to be scarcely restricted at all. Thus the limb readily empties itself of blood and there is no increased resistance or back pressure to encourage collateral circulation from the remaining normal arteries.

High ligation of the main vein under these circumstances offers a marked resistance to the outflow of blood and an increased venous and capillary pressure, which in turn should direct a greater volume of collateral blood from the normal arteries of the limb into anastomosing channels that will eventually reach the distant capillary bed. This is the desired end, for, until we discover the cause of this mutilating disease, our only hope in overcoming its ravages is the production of a sufficient collateral circulation. As Meleney and Miller¹ have previously pointed out "A contest develops in this disease between two forces, blockage of vessels on the one hand, and collateral blood-vessel development on the other, and the outcome is determined by the relative speed of the two processes."

This attempt to help nature in the production of a collateral circulation is at best an indirect method of attack against the disease, but if it can succeed in conveying blood to parts which are dying simply for lack of it, pain will have been relieved and gangrene prevented.

In evaluating the results of high vein ligation as a conservative therapeutic measure in the treatment of thrombo-angitis obliterans, we are led to believe from this series of cases that the procedure is of definite value in affording relief from pain in combating impending or advancing gangrene, and in postponing if not obviating high amputation.

CONCLUSIONS

1 High ligation of the vein in the treatment of thrombo-angitis obliterans is justified, and is to be highly commended.

2 Of nine cases of this disease treated by this method, pain was controlled, and gangrene arrested or improved, in eight.

3 Ligation of the external iliac vein does not appear to have any marked advantage over ligation of the superficial femoral vein in Scarpa's triangle, so far as could be determined by post-operative clinical observation in this series of cases.

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4 Of all the forms of conservative treatment employed in this clinic for thrombo-angitis obliterans, high ligation of the vein appears to be by far the most promising

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RECONSTRUCTION OF THE HIP-JOINT IN CONGENITAL DISLOCATIONS

BY WILLIAM JACKSON MERRILL, M D

OF PHILADELPHIA, PENNA

THE finding of sad results from methods that have not been productive of requisitely substantial bone building after acetabular reconstruction lead to the thought that a displacement *in toto* of the malformed acetabulum would be more satisfactory. Bone chips or frail segments have often failed, when a transposed acetabulum undisturbed in structure and innate function would have succeeded.

Functional results of this operation cannot be given here but since the mechanics of the operation have been carefully tested and advantages evinced

it seems to be opportune to give a preliminary report of a measure in hip-joint reconstruction which the author has employed in a few cases.

Four years ago, when reconstructing a hip-joint a frail, thin ilium was encountered. There was three inches shortening, and an almost vertical pitch to the acetabulum. The writer proceeded as follows. A U-shaped incision was made around the upper half of the deformed acetabulum. The ilium was so frail that it seemed best to turn down both tables. On account of the wide discur-

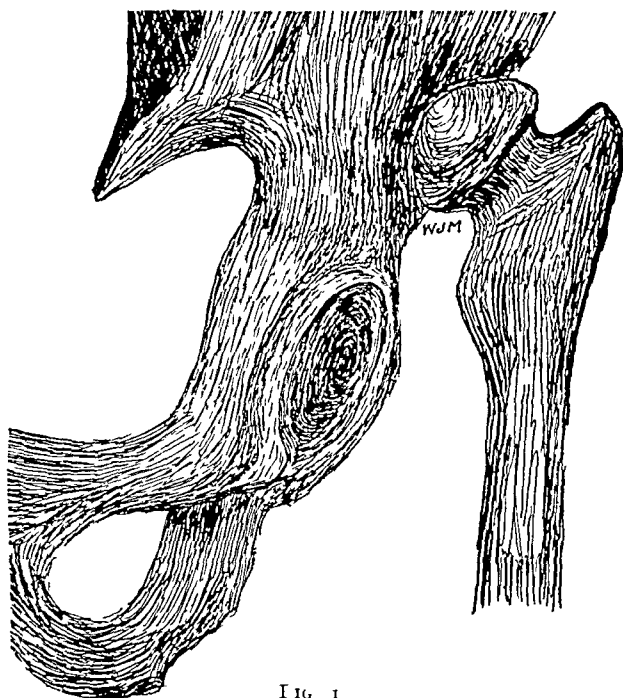


FIG. 1

sion of the head and the threatened pressure of it in the new acetabulum after reduction, the rectangle was completed to include the entire shallow diminutive acetabulum. This was displaced obliquely outward and upward and tilted outward over the femoral head. It was made fast by sutures and became a solid part of the ilium.

With this case as a stimulus the writer experimented on the cadaver to study the mechanical behavior of a segment of the ilium including the upper portion of the brim, as compared with frail pieces of bone from the ilium or elsewhere, the continuity of which is always more or less disturbed. The

CONGENITAL HIP-JOINT DISLOCATIONS

writer's object was to move the segment outward and tilt it outward, which on account of its shape would move upward a little Dr Paul N Jepson assisting in the experimentation suggested that it be moved outward and distinctly upward

A rectangular section was made including the roof and half of the floor This was displaced upward and outward and tilted outward, eliminating encroachment upon the acetabulum and extending the roof well out over the femoral head Often bone chips and frail segments do not produce resistant bone and the "breaking down" of the roof causes encroachment on the already diminutive acetabulum and relative shortening of the roof, moreover, the impingement of it on the femoral head tends to force the

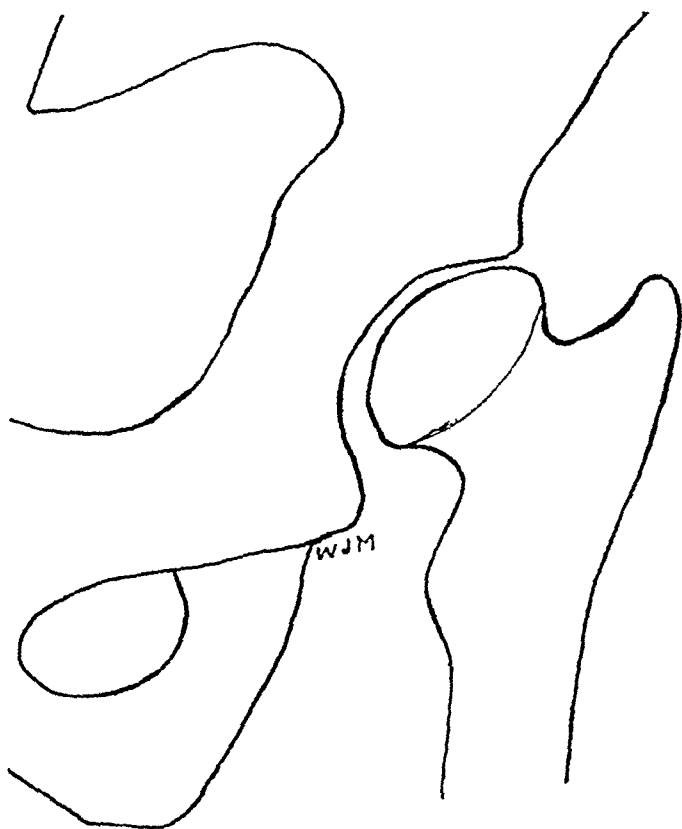


FIG 2

latter outward Figure 1 illustrates the difficulties of replacement and maintenance of reduction

Figure 2 shows the insecure head easily dislocated when bloodless reduction is accomplished

Figure 3 demonstrates the incomplete roof when any method has failed to carry a substantial roof well out over the femoral head

Figure 4 denotes the method by which the writer strives to secure a robust acetabulum The segment is made by a transverse incision, far enough above the margin of the acetabular brim to obtain bone of proper integrity, two vertical incisions, completely through ilium, one anterior and one posterior in similar

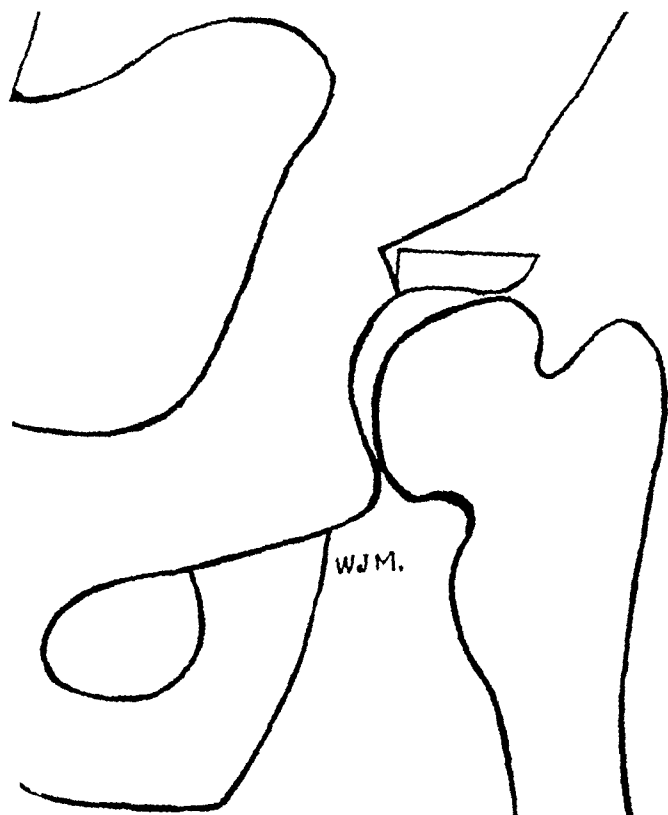


FIG 3

relation with the brim as the upper transverse cut, and a fourth transverse cut through the centre of the floor. This rectangular segment is displaced

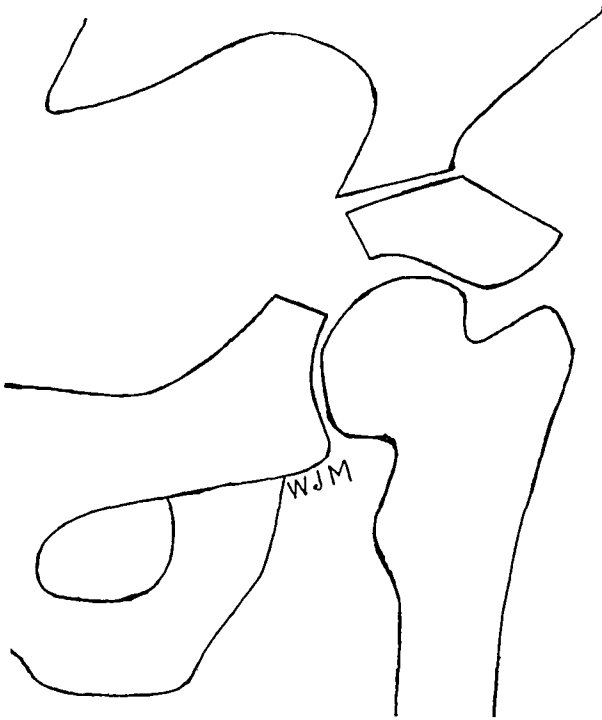


FIG 4

upward and outward and tilted outward. The upward movement should be the least possible to minimize shortening. This outward and upward displacement of the roof facilitates reduction. The writer has found that the ilium at the site of the acetabulum, in congenital dislocation of the hip-joint, is often frail and comparatively thin. When it is, a transverse section is practical. When it is not, a segment of the ilium, deep enough to insure robust bone, undisturbed in continuity, is easily obtained.

bed with traction to the limit of toleration for a time sufficient, months if necessary to accomplish complete relaxation and stretching of the soft parts of hip and thigh, to favor a comparatively easy reduction and to minimize the pressure of the femoral head in the new acetabulum after reduction.

The moderate shortening in the unilateral cases is of less importance than the results of undue stress in handling, and pressure when the femoral head is forced and held at a lower level.

After the operation abduction, as indicated in

each case is maintained until the X-ray indicates that the bone will withstand weight-bearing stress without undergoing absorption. This is maintained by plaster bandages, followed by an abduction walking brace until the stability and integrity of the joint are assured, even for a period of five years.



FIG 5

CONGENITAL HIP-JOINT DISLOCATIONS

after operation. Many mechanically successful operations are vitiated by undue pressure and too early function. Function is commenced as indicated and gradually increased, the results being noted by frequent X-ray studies. The leg is not brought to the mid-line until the conditions of the joint structures are satisfactory.

Figures 5 and 6 are of an X-ray of a bilateral case which the writer treated by manipulation. The head of the left femur was reduced on first attempt and remained *in situ*. Two futile attempts were made at bloodless reduction of the right, but



FIG 6

reduction could not be maintained. The most recent displacement operation by the author was on this case, right hip. Traction to the limit was made for over nine months, facilitating the certain steps in the operation and the reduction as well as augmenting maintenance of position.

This operation is presented with the belief that it is productive of a better-formed, more robust acetabulum, assuring a higher degree of stability and function than has heretofore been obtained by other methods.

TRANSPLANTATION OF URETERS FOR IRREPARABLE BLADDER INJURY

By W LOWNDES PEPLE, M D

OF RICHMOND, VA

MRS H N C, age twenty-five, was admitted to St Luke's Hospital, Richmond, Va, August 1, 1926. At the time of her marriage about a year and a half ago she was an active healthy young woman about five feet two inches in height, and weighing 110

pounds. She became pregnant, and went to term without any untoward incident arising. Prior to delivery she was found to have a moderately contracted pelvis, but this was not thought to be enough to preclude a natural delivery. She went into labor May 15, 1926, when according to calculation she was two weeks overdue. To quote the attending physician:

'The membranes ruptured very early and after a rather long labor with very slow progress the occiput presented posteriorly, and all attempts to correct it ended in failure. A podalic version was done, as gently as possible, but with great difficulty on account of the early loss of the water. The delivery of the head and shoulders was extremely difficult, though a double episiotomy was done, and the work was carried on as gently and as slowly as seemed advisable with a patient badly shocked and bleeding rather freely. The delivery was finally completed without any apparently great mutilation to the baby or the mother. A small tear was noted in the floor of the bladder and an almost complete tear in the perineum.

Immediate repair was not attempted on account of the patient's condition of severe shock. She later developed an infection, sloughing started in the pelvic tissues, and it looked as if everything in this area would slough away.

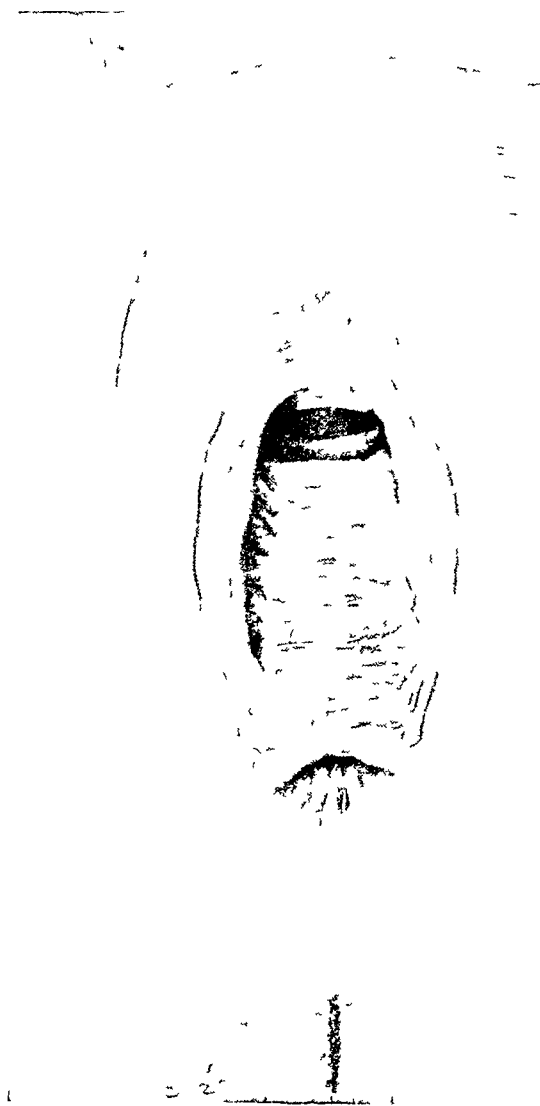


FIG 1—Condition prior to operation showing hole in floor of bladder, absence of urethra and complete perineal tear into the rectum.

TRANSPLANTATION OF URETERS

"About seventeen days after delivery she developed a complete paralysis of the right side of body, as a result of an embolus to her brain. When the sloughing ended it was found that practically the whole floor of the bladder and the urethra had sloughed away."

She came to St. Luke's Hospital August 1, 1926, directly from the hospital in which she had been delivered after a stay there of three and a half months. She weighed then 105 pounds, though she looked pale and anæmic. She had fully regained her speech and she could walk a little with assistance, and was using her right arm and hand fairly well, though her movements were slow and spastic. She had 3,600,000 red cells with hæmoglobin 65 per cent. Her Wassermann was negative. Her temperature was 99°, but it was very variable, jumping up with slight exciting causes. Her pulse was about 80 but ran up under excitement to 110. She had not menstruated since her delivery.

Vaginal examination revealed a complete perineal laceration, well up into the rectum. The sphincter was torn and separated, and there was little or no control left. The cervix could scarcely be made out, because of the scar tissue involving it. There was a hole in the vault of the vagina about an inch and a half in diameter. Its edges were hard and unyielding. It was just behind the pubic arch and was bounded laterally by the rami. There was no vestibule. The entire urethra was gone. The mucosa under the arch was tightly attached to the perios-



FIG 2—Patient after perineorrhaphy with restoration of the anal sphincter

teum. The mucosa of the collapsed upper wall of the bladder bulged through the opening and presented in the vagina. The skin about the vulva and nates and anus was red and excoriated from the urine and feces constantly passing over it. Life was made tolerable by the frequent change of napkins and pads and the constant free use of soothing dusting powders.

Since the urethra and its sphincter, as well as the tissues in which it should lie, were missing, any effort at rehabilitation of the bladder would manifestly be futile. It was decided, therefore, to implant the ureters into the bowel. But, as the rectum was also open and its sphincter divided, it was again plainly necessary to restore it to competency first, for with urine pressing against it from above, if the ureters should first be implanted, healing would be difficult if not impossible.

Accordingly, September 3, a perineorrhaphy was done, suturing the torn rectum and approximating its sphincter and the vaginal mucosa over it. The operation was made difficult because of the brawny inelastic nature of the tissues after so much sloughing and subsequent inflammation, and the irritation of the urine and bowel excretions constantly bathing them.

As a preliminary step the ureters were catheterized and the catheters left in place to try to maintain a dry wound. This was not satisfactory, however, for the urine came

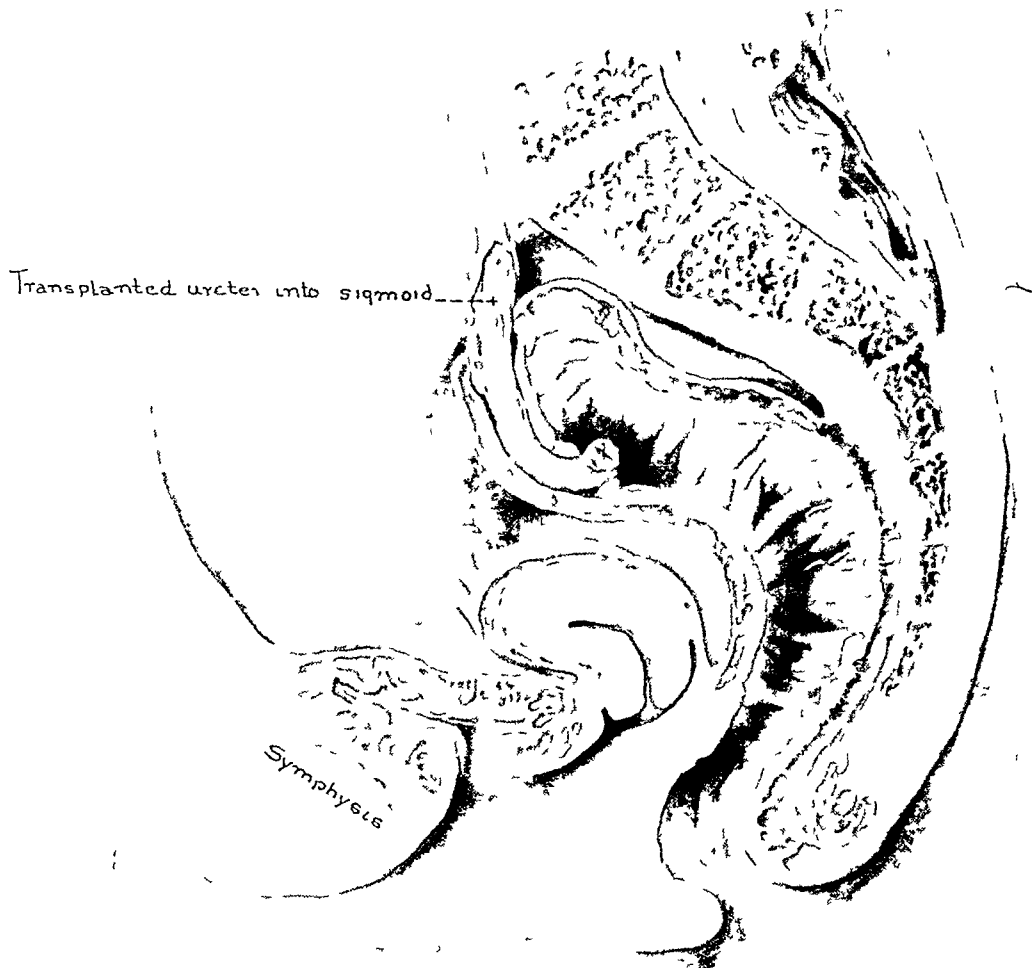


FIG 3—Sagittal view of the pelvis showing opening in floor of bladder, and right ureter implanted into the sigmoid

around the catheters and flowed over the wound, and we only succeeded in setting up a pyelitis with a high temperature which took several days to subside.

The result, though cosmetically imperfect, was practically excellent, because it gave her a continent rectum.

She was sent home now for six months, to allow her to build up, to further recover from her paralysis, and above all to allow her to become cognizant of the altered social relations to those about her. She had been in hospitals continuously since her first illness, and most of the time in bed, with no opportunity to mingle with people other than her family.

She returned to St. Luke's April 5, 1927, having gained in weight and strength. She could now walk about without help and could use her hand quite well. She had

TRANSPLANTATION OF URETERS

perfect control of her anal sphincter and was quite comfortable in that respect. She had commenced going out among people and after trying some strap-on urinals had gone back to cloths and pads again, and was now quite ready for any operation that would render her condition less intolerable. One other feature had been added to the case. Shortly after leaving St. Luke's, about October 10, 1926, she began having slight convulsive seizures starting in the right side of the face and in the right arm and leg with muscular twitching, a slight Jacksonian epilepsy. These were controlled well with small doses of luminal.

April 7, 1927, a median section was done. The uterus was small and in good position and freely movable. The right ovary was large and cystic and the appendix was subacutely inflamed. The left ovary was normal. The appendix and the right ovary and tube were removed and the left tube ligated and divided to avoid the possibility of any future pregnancy. The right ureter was then implanted into the sigmoid, choosing a coil as low down as it could be had to lie easily against the right pelvic wall. The technique was that described by Dr. Charles H. Mayo in his operation for ectrophy of the bladder. We followed this in close detail except that a preliminary catheterization of the ureter was done to make its location easy and convenient. This step I would earnestly commend to any occasional operator. The saving of time and unnecessary trauma will greatly outweigh the danger of infection. The steps of the operation, the curved incision along the longitudinal band, the puncture of the mucosa and the threading back of one end of the catgut traction suture into the cut ureter, to insure patency of its lumen, the covering of the ureter with the muscular and serous coats, were all quickly and easily accomplished.

Except for a rather severe febrile reaction following the operation the patient made a good operative recovery. Urine appeared in the rectum in about thirty-six hours, apparently about half the output. To be sure the kidney was functioning we gave indigo carmen intravenously and quickly recovered it through a catheter in the rectum. Control of the rectal sphincter with the added factor of irritating urine from above was complete and satisfactory. She held it from four to six hours and voided easily, with little burning or irritation.

April 25, eighteen days after the first operation, we did the second ureteral implantation. As there was no suppuration in the first incision which was median, we went through it again, thus leaving only one scar.

I would again emphasize the value of the ureteral catheter *in situ* as a guide in quickly locating the ureter, for I feel that the second operation would have been very difficult without this aid.

There was far less reaction from the second than from the first operation and her control of the added urine in the rectum was prompt and complete. She went from two to four hours from the first, and at times did not have to void all night. There was a slight mucous secretion from the bladder, but this seemed to give little trouble. She left the hospital May 20.

In a letter received from the patient November 15, in reply to one from me in which I asked certain specific questions as to her present condition, I learned that her general condition is most satisfactory. The attacks of muscular spasm now come on the first day of menstruation, which has been re-established. They last only about five minutes and are very slight in character. She goes two or three hours without voiding in the day, and rarely gets up at night. The control of the urine is perfect and there is no irritation about the rectum or anus. The mucus from the bladder is very small in amount and gives no trouble whatever.

BRANCHIAL CYSTS OF THE PAROTID GLAND

BY WILLIAM F CUNNINGHAM, M D

OF NEW YORK, N Y

FROM THE FIRST SURGICAL DIVISION OF BELLEVUE HOSPITAL

THE cystic and solid tumors and sinuses which arise in the region between the parotid gland and the manubrium that develop from the remains of bran-

chial clefts or the organs which arise from them have two histological characteristics, an epithelial lining and a wall containing lymphoid tissue. The solid tumors occurring in the anterior triangle of the neck, such as branchogenic epithelioma, are not always attended by such lymphoid development and it is, therefore, often difficult to determine whether they arise from branchial remains or are of metastatic origin. Certain cysts that develop in the parotid gland are characterized by a lining of stratified columnar epithelium and a wall containing lymphoid tissue.

These cysts may be sin-

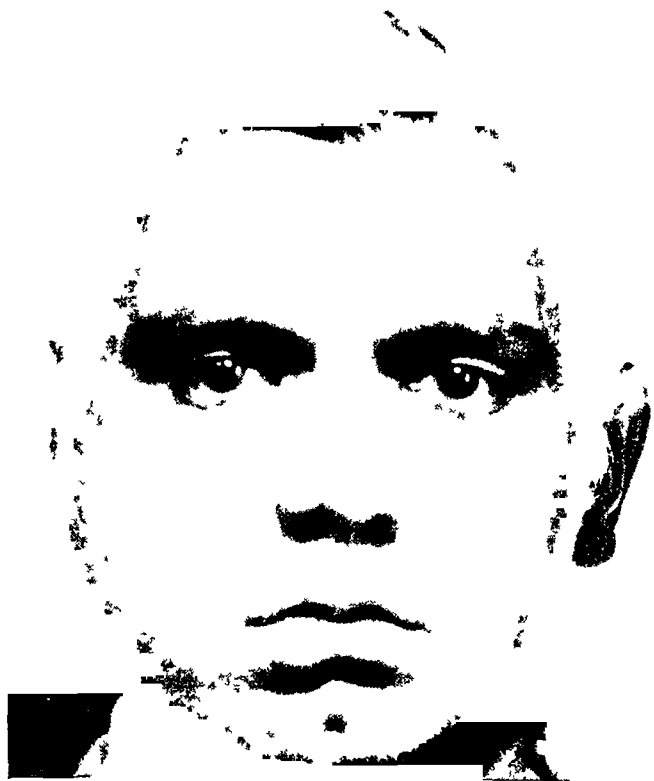


FIG 1—Front view showing right side enlargement in parotid region

gle or multiple and may undergo inflammatory changes with the production of sinuses similar to those springing from thyroglossal and branchogenic remains.

The parotid glands develop from the ectodermal oral sinus portion of the mouth as an epithelial growth. Menetrier¹ has shown that the parotid glands of the foetus and the new-born consist of lymphoid tissue with acini irregularly distributed through it.

Menetrier¹ describes a tumor that was the size of an egg with multiple cyst formation removed from the parotid region. The lining was thrown into folds and covered by stratified columnar epithelium while the matrix was richly provided with lymphoid tissue. He refers to this as a parabran- chial cyst in

BRANCHIAL CYSTS OF THE PAROTID GLAND

contradistinction to those cysts which arise directly from the remains of branchial clefts. Lecene² reports two unilocular cysts of the parotid gland of similar morphology and refers to two others in the literature. Chevassu³ describes a cyst of the region of the manubrium with a stratified columnar epithelial lining and a wall composed of lymphoid and salivary gland tissues.

Houdard⁴ refers to a multilocular parotid cyst, but the morphology is typical of a papillary cyst adenoma and has considerable lymphoid tissue distributed through it. Two unusual cysts are reported by Peyron⁵ that were removed from the carotid region. The walls contained Hassall's corpuscles indicating that they developed from a rudiment of the thymus gland. Thus it appears that there may be wide variations in the structure of these branchial remains depending on the pouch or bar from

which they arise. The following case is of interest because of the confusion it offered when first presented for diagnosis, because of the rarity of this type of lesion and because it is amenable to no treatment other than total or subtotal sialo-adenectomy.

CASE REPORT

History No 6911, First Surgical Division Bellevue Hospital. The patient sixteen years of age, was admitted February 2, 1928, with the history of a swelling in the right parotid region of over three years' duration. The mass opened spontaneously on several

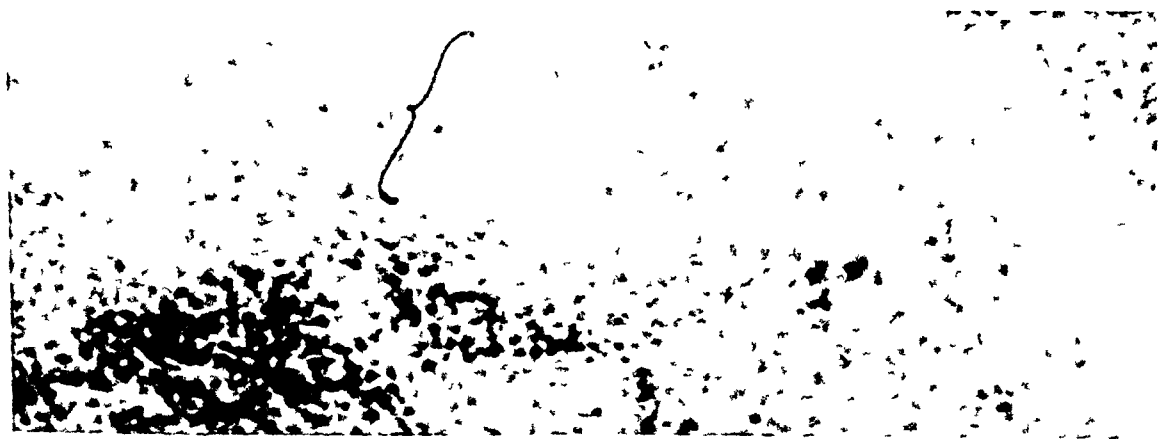


FIG. 3.—Showing stratified columnar epithelium.

occasions and discharged purulent material for a time. The patient was operated on for double otitis media and mastoiditis in 1925. Otherwise the patient has enjoyed good health.

Physical examination was negative except for bilateral chronic otitis media and the local condition. There was a hard mass involving almost the entire parotid gland with three stomata discharging seropurulent material. On pressure the same sort of material could be forced through Stenson's duct. A tentative diagnosis of tuberculosis of lymph nodes with parotid extension or actinomycosis was made. The smear, however, was negative for ray fungi although it contained microorganisms morphologically resembling pneumococci. Biopsy was done the tissue being taken from one of the sinuses and this revealed a chronic inflammatory process.

Operation—April 3, 1928. *Pathology*—(1) Linear red scar from biopsy. (2) Three sinuses emitting purulent material. (3) Enlargement of parotid gland with chronic productive inflammation and multiple small cavities with well-developed walls.

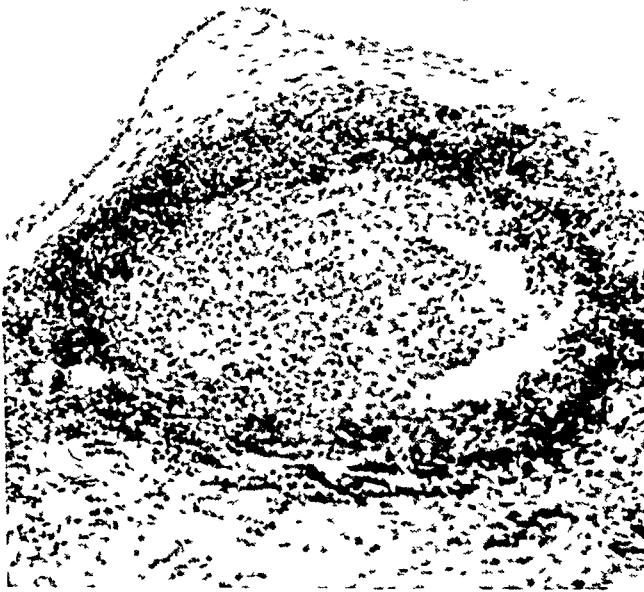


FIG. 4—Showing lymphoid follicle in wall of cyst

Procedure—(1) Excision of two sinuses and previous scar through transverse incision. (2) Identification of facial nerve. (3) Excision of lower two-thirds of parotid gland by sharp dissection. (4) Closure of wound by a subcuticular suture of plain catgut.

The operative diagnosis was cystic degeneration of parotid gland.

Microscopical Examination by Dr. A. P. Stout—"The sections Figs 3 and 4 have been stained with ponceau, acid fuchsin, aniline blue and Regaud's hematoxylin, with metanil yellow, acid fuchsin and Regaud's

hematoxylin, and with Mayer's mucicarmine. These show that the cysts are lined with a stratified cuboidal and columnar epithelium beneath which are masses of lymphoid tissue. The salivary gland tissue surrounding them is imbedded in thick masses of fibrous tissue. The cells lining the cysts in a few places are covered on their surfaces with flecks of mucus, but none is seen within the cell body. The salivary gland acini also show some flecks of mucus in one or two places.

On April 20, 1928, patient was allowed to go home. There was at the posterior angle of wound a sinus discharging a small amount of seropurulent fluid. (There was no evidence that the facial nerve had been traumatized.)

SUMMARY

Certain solitary and multiple cysts develop in the parotid gland that are of branchogenic origin. The differential diagnosis may be made from an histological study of the lining cells. Solitary cysts are easily enucleated but the parotid gland, which is the seat of multiple cysts, necessitates total or subtotal sialo-adenectomy.

BRANCHIAL CYSTS OF THE PAROTID GLAND

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TRANSACTIONS OF THE NEW YORK SURGICAL SOCIETY AND THE PHILADELPHIA ACADEMY OF SURGERY

JOINT MEETING HELD FEBRUARY 13, 1929

DR FRANK S MATHEWS in the Chair

TUBERCULOSIS OF THE THYROID GLAND WITH SECONDARY LYMPH NODE INVOLVEMENT

DR CARL EGGERS, of New York, presented a woman, thirty years of age, who was admitted to the Lenox Hill Hospital, June 7, 1926, complaining of swellings in the neck associated with pain. She had been well until a year before when she developed occasional sharp pain in the right side of neck which did not yield to treatment. About six months later the thyroid gland began to enlarge and soon after enlarged lymph nodes began to appear on the right side of the neck. The pain had become worse, was constantly present, and radiated to the teeth and right ear. There were no other symptoms of constitutional disease. She was married and had one healthy child. Her menstruation was normal.

The patient was a well-developed, fairly healthy-looking woman. She weighed 122 pounds. The general examination showed nothing grossly abnormal. The outstanding feature was an enlarged thyroid and a chain of enlarged lymph nodes on the right side of the neck. Both lateral lobes of the thyroid were enlarged, they were nodular and unusually hard, and quite tender to touch. The pulse rate was increased to ninety, and there was tremor of the hands, but there were no other symptoms or signs of hyperthyroidism. The posterior chain of lymph nodes on the right side of the neck was enlarged, the glands felt very hard and were not adherent to the skin. The basal metabolism rate was +23. The blood count showed 4,032,000 red blood cells with 81 per cent hæmoglobin, leucocytes 8200 with 61 per cent polymorphonuclears. The urine was negative. The nasopharynx was negative.

At operation the affected lymph nodes were removed first through a four-inch incision along the posterior border of the sternocleidomastoid muscle. The entire chain of nodes was removed in one mass, beginning the dissection below the mastoid.

A subtotal thyroidectomy was then done, leaving only a small portion of soft thyroid tissue posteriorly. There was very little bleeding. The gland tissue on section looked pale and rather fibrous. It was very hard.

The convalescence was uneventful and both wounds healed by primary union.

The pathological examination showed chronic tuberculous lymph adenitis and chronic tuberculosis of the thyroid gland. The following is a detailed microscopic report submitted by Dr F D Bullock.

Sections of several of the nodes show discrete and confluent tubercles in a good state of preservation, and large caseous areas surrounded by epithelioid cells and scattered tubercles. There is considerable fibrosis of the nodes and fibrous thickening of the capsules.

Sections of the thyroid show the thyroid tissue to be divided up into lobules of different sizes by bands of dense fibrous tissue. The interlobular stroma is increased in amount and the parenchyma is mostly atrophic. Both the interlobular and intralobular fibrous tissue show an infiltration of many small round cells. Scattered here and there through the gland are giant cells and collections of epithelioid cells which sometimes surround multinucleated giant cells. There is no evidence of malignant disease.

HÆMORRHAGE FOLLOWING GASTRO-ENTEROSTOMY

The patient subsequently developed enlarged lymph nodes in the right supraclavicular fossa which were removed, May 21, 1928, and were also reported to be tuberculous. Except for this she has remained well. At no time have there been symptoms or signs of tuberculous involvement of the lungs or any other organ.

Tuberculosis of the thyroid gland is a rather rare condition. The more acute form is usually found in general systemic tuberculosis and appears as miliary tubercles throughout the gland. It is of little interest to the surgeon.

The more chronic type may appear in an otherwise normal gland or in a gland showing other pathological changes such as adenomata. One may find tuberculous granulation tissue, caseation, abscess formation or fibrosis, depending on the severity of the infection, the length of time it has existed and the resistance of the patient to the infection. Surrounding structures may become involved, and frequently the lymph nodes draining the gland become affected. The presence of tuberculosis in the gland usually tends to hyposecretion from pressure on the normal tissue rather than to hypersecretion. Subtotal thyroidectomy performed before the disease has spread to surrounding structures offers a good prognosis.

GASTROTOMY FOR HÆMORRHAGE FOLLOWING GASTRO-ENTEROSTOMY

DOCTOR EGGERS presented a man, twenty-nine years of age, first seen by him October 16, 1928. He had symptoms of duodenal ulcer on and off for ten years, and for the last four years had been under competent medical care. In spite of this the condition recurred every few months. Each attack lasted three or four weeks. His chief complaint was pain coming on either before or after meals. Sometimes it was relieved by eating. He also complained of nausea, but there was no vomiting. Lately he had been failing, and he had lost eight pounds during the preceding month. Gastric analysis and X-ray examinations had repeatedly been done corroborating the diagnosis of duodenal ulcer.

After admission to the hospital his gastro-intestinal series was repeated, and showed constant deformity of the duodenum without retention. A test meal showed high acidity. Blood examination and Wassermann were negative.

Operation was performed October 26, 1928. The stomach was about normal size. Its prepyloric region was red in color. About half an inch below the pylorus a chronic ulcer was visible on the anterior surface of the duodenum. It was not particularly infiltrated, but had produced decided narrowing of the lumen with dilatation of the duodenum above, suggestive of a diverticulum. A short loop posterior gastro-enterostomy was done, using chromic catgut for the inner and silk for the outer suture. Special care was used to ligate the small vessels on the stomach and gut before incising the mucosa. The operation was smooth and satisfactory. There was no bleeding. The stomach was fastened into the slit in the transverse mesocolon and the abdomen then closed. Patient left the table in very good condition.

About two and a half hours later he vomited a small quantity of blood which was attributed to oozing from the suture line. No special attention was paid to it and a hypodermic of morphine ordered. After that he vomited several times, each time a large quantity of blood, both fluid and clotted, amounting to approximately 1600 cubic centimetres in all. He failed rapidly, looked shocked, perspired profusely and his pulse was small and thready, 130-140 per minute. The abdomen was again opened seven hours after the gastro-enterostomy. A transfusion had been ordered in the meantime but there was difficulty finding a donor. Though several donors of the same blood group were brought to the hospital the blood of none of them matched and it was not until the next day that a transfusion from the patient's brother could be given.

A hypodermoclysis of Ringer's Solution was started before the operation was begun. When the wound was reopened, the abdomen looked clean and the organs were in normal position. The stomach was not dilated and showed good tone. (He had vomited just before operation.) A gastrotomy was done by a vertical incision through the anterior wall of the stomach, directly opposite the gastro-enterostomy. The blood within the stomach was removed by suction and the stoma was then inspected by everting its margins. At first no bleeding point was noted but after allowing the tissue to relax, active bleeding was found along the posterior margin of the stoma. The blood was bright red, evidently arterial in character, but there was no spurting, perhaps due to an overlying fold of mucosa. Several mosquito clamps were quickly applied and six or seven fine chromic catgut sutures were inserted until the field was completely dry. The gastrotomy wound was then closed and the stomach replaced. Abdomen closed without drainage.

During the operation an infusion of 550 cubic centimetres of Ringer's Solution was given. The patient was badly shocked and active stimulation was resorted to. When it was impossible to get a donor another infusion of glucose solution was given later.

The progress during the first few days after operation was slow, but with stimulation and subcutaneous administration of Ringer's Solution he gradually improved until a few days later he again began to vomit, had sunken eyes and a distended abdomen. Acute dilatation of the stomach was diagnosed and after a gastric lavage with the evacuation of enormous quantities of greenish-brown fluid definite improvement set in. He gained rapidly and was discharged four weeks after operation. He has remained well and his pre-operative gastric symptoms have cleared up. Röntgen-ray examination shows good function with emptying through the stoma complete after two hours.

Vomiting of a small quantity of blood or blood-stained fluid after a gastro-enterostomy is not uncommon and is no doubt usually due to oozing from the suture line. It may at times be due to oozing from the ulcer resulting from manipulation at the time of operation. It usually stops spontaneously. Real hæmorrhage is uncommon. The speaker had seen it only twice. In his very first case of gastro-enterostomy it came on about twenty-four hours after operation. The second case was the one now reported. In the former the bleeding was controlled by gastric lavage, with hot saline solution containing adrenalin, and the administration of medication aimed at favoring clotting of blood. By keeping the stomach empty and allowing it to contract the bleeding ceased and he made a good recovery.

In the present case administration of coagulen had no effect, and transfusion could not be used for its blood clotting properties because of the inability to find a proper donor. Moreover the bleeding was so active and the patient failed so rapidly that it seems his life was saved only by the direct attack on the bleeding point.

DR ARTHUR E. BILLINGS, of Philadelphia, remarked that Doctor Schwartz had reported eight instances of hæmorrhage in a series of 398 cases following simple gastro-enterostomy, an incidence of nearly 2 per cent. Three of these cases died giving a mortality of slightly less than 1 per cent. In the April, 1928, issue of *Surgery, Gynecology and Obstetrics*, Dr. William L. Estes, Jr., of Bethlehem, Penna., reported two cases similar to Doctor Eggers' case. Active bleeding occurred a few hours after operation. He operated on both of them, invaginating the line of anastomosis through the stoma into the stomach and suturing with chromic catgut. Both cases recovered.

PYONEPHROSIS WITH SUPERNUMERARY KIDNEY

In cases where frank hæmorrhage of several ounces of bright red blood occurs a few hours after operation, surgical intervention is demanded. The use of clamps as a routine procedure has been sacrificed by a number of surgeons for simple traction and suture whereby the active bleeding points in the line of anastomosis can be treated by direct ligature. The speaker emphasized the value of one point in the technic of gastrotomy and that was the use of the Cameron light. It is of distinct advantage in some cases where the stomach is to be explored for a bleeding point.

PYONEPHROSIS, LEFT, WITH SUPERNUMERARY KIDNEY AND URETER

DR JAMES I. RUSSELL presented a woman, twenty-four years of age, who was admitted to hospital with a ten-day history of pain in the upper lumbar and left costo-vertebral region, of rather sudden onset, increasing in severity the first few days. For several days prior to admission symptoms had somewhat subsided. She had previously felt perfectly well, past history entirely negative, no boils, no carbuncles, nor tonsillitis.

On admission Temp 102.8°, white blood count 12,400, polymorphonuclears 69 per cent, and a moderate degree of secondary anæmia.

There was a firm, large and comparatively fixed mass in the left upper quadrant of the abdomen, extending down to the iliac crest. It was not particularly tender. It was dull on percussion, the dullness extending upward to the left nipple. The tympanic colon was in front of the mass.

Voided specimens of urine contained large quantities of pus, but this was apparently largely contamination, as, with one exception, catheterized specimens rarely showed many pus cells. The patient, however, had not previously noted any purulent vaginal discharge.

She was kept under observation for some time, temperature ranging from 100 to 103 degrees, during which time a thorough search for tubercle bacilli in the urine was being made. On two separate cystoscopic examinations clear urine was obtained from both kidneys and was sterile when cultured. The left ureter was obstructed by partial angulation opposite the fourth lumbar vertebra. Pyelogram showed point of obstruction near the kidney pelvis with marked dilatation of the proximal half of the ureter.

The second pyelogram showed a massive dilatation of the upper half of the left ureter and the left kidney pelvis with a marked ptosis of the pelvis.

Blood culture, Widal and Wassermann were all negative. Blood chemistry was essentially normal. No tubercle bacilli could be found.

She was given a blood transfusion and operated upon during the second week in the hospital (December 17, 1928), with a temperature slightly higher than previously.

Through an oblique lumbar incision a large cystic mass was encountered apparently within the parenchyma of the kidney, containing about one and one-half quarts of thick yellow pus. There was a veil-like tissue in the lower portion of this which shut it off from a large dilated ureter which extended down posteriorly over what proved to be a normal kidney. After evacuating the contents and dividing the large dilated ureter the cyst wall was dissected out. The lower portion of this was attached to the upper pole of an apparently normal kidney which had its own vessels and separate ureter, and which was removed with the cyst wall.

Convalescence was normal. Vaginal examination failed to disclose any evidence of aberrant opening of the ureter.

Microscopically—The renal tissue removed from the intact lower kidney showed normal picture. All the sections of the dilated upper sac showed its walls to be composed of a mass of chronic inflammatory tissue in which could be detected renal tubules. The section of ureter enabled one to detect all of its layers, throughout which there had been a dense invasion by lymphocytes and plasma cells.

The patient was discharged from the hospital on the twenty-seventh post-operative day entirely free from symptoms. She has gained weight and strength, and is now in good health.

DR LEON HERMAN, of Philadelphia, considered Doctor Russell's case to be an instance of incomplete reduplication of the ureter commonly called double pelvis. In these cases there is rarely external evidence of the reduplication in the form of grooves or depressions in the parenchyma dividing the organ incompletely into two segments. Rarer still is there complete separation, in which event the smaller segment constitutes a supernumerary or accessory kidney.

The minor degrees of incomplete reduplication of the upper ureter and pelvis are commonly encountered by the cystoscopist and offer several problems in diagnosis. First, in the event that the catheter tip is introduced into the healthy portion of a double pelvis, the other portion being diseased, it is possible on this account to be misled by the normality of the urine obtained, and to overlook the disease. Furthermore, one may be misled concerning renal function, the catheter draining only one-half or less of the kidney.

In more advanced states of reduplication, there is likely to be more decided separation of the segments of the kidney drained by each ureter, and while rarely performed successfully the operation of heminephrectomy must be considered. The failures with the operation are attributable in some instances to disease, such as tuberculosis, but more often to technical difficulties among which the impossibility of isolating the ureters due to their residence in a common sheath, or an impossibility of preserving the blood-vascular supply to the healthy segment, is important.

Among a series of more or less complete ureteral reduplications, only one was heminephrectomized successfully. This patient, a girl eighteen years of age, had complete reduplication of the left ureter, normal upper segment and pyonephrotic lower segment of the left kidney, and a ptosed hydronephrotic right kidney. The latter showed less function to phthalein than the upper normal segment of the left kidney and seemed unable to support life unaided. For this reason, operation on the left kidney was feared lest nephrectomy should prove necessary. This became imperative, however, and heminephrectomy was successfully performed. The remaining segment of the left kidney is now a better functioning organ than the right kidney. The operation was quite easy owing to the fact that the main vessels were attached to the healthy segment and the ureters widely separated. This is one of the rare exceptions to the usual practice. As conditions encountered in Doctor Russell's case show, total nephrectomy is necessary in most instances.

CARCINOMA OF CÆCUM

CARCINOMA OF CÆCUM—INTUSSUSCEPTION

DOCTOR RUSSELL presented a man, forty-six years of age, who was admitted to hospital, January 2, 1926, with a complaint of irregular, cramp-like pains in the right lower quadrant of the abdomen of eight months' duration, coming on following a herniotomy. He had been considerably constipated since the onset of his symptoms, but otherwise he felt well. There was no nausea or vomiting. He had lost thirty-eight pounds in weight during the past eight months. He had taken large amounts of morphine to keep free from pain.

An indefinite mass could be palpated beneath the recti muscles in the centre of the abdomen. It was fairly well fixed and somewhat tender.

He was suffering from a moderately advanced degree of secondary anæmia. White blood count 11,200, polymorphonuclears 86 per cent. Blood chemistry was essentially normal. He had no fever. Urine was negative.

Barium enema showed partial obstruction in the proximal portion of the transverse colon and the edge of a moderately enlarged liver. Character of obstruction was not determined.

Exploratory laparotomy was performed January 7, 1926. This revealed a chronic intussusception of the cæcum and ileocæcal junction into the transverse colon, apex being nearly over to the splenic flexure. The intussusception was reduced by manipulation without injury to the gut wall. An intra-intestinal tumor could then be felt in the cæcum. The cæcum was brought up into the wound and anchored with stitches.

Four days later the cæcum was incised. A pedunculated tumor was found projecting into its lumen. Its pedicle was divided and the tumor removed and the defect in the cæcal wall closed by sutures. The attachment of the pedicle was found to be below the level of the ileocæcal valve.

The pathological specimen consisted of a very firm, ovoid mass 4x3x3 cubic centimetres in size, roughened on its surface. Cut section showed a hard, whitish, fibrous-looking mass, covered on the surface by softer grayish tissue, infolded in areas.

Microscopic examination showed areas of normal-looking glandular mucosa, considerable fibrous tissue stroma, in places typical solid masses and cords of invading epithelial cells, definitely carcinomatous in nature. No mitotic figures were seen. Two weeks later a third operation was performed consisting of an enterocolectomy, lateral anastomosis. Four centimetres of terminal ileum and fifteen centimetres of the cæcum, ascending colon, were removed and showed no evidence of malignancy in either gross or microscopic examination. Lateral anastomosis was effected between the terminal ileum and the ascending colon.

The patient was discharged on February 19, twenty-five days post-operative, with the wound well healed after very moderate suppuration. There was no fæcal leakage. Bowels are now normal without catharsis. He has gained weight, digestion is good.

DR JOHN H. JOPSON, of Philadelphia, said that polypoid tumor of the intestine is a well-recognized factor in intussusception. In one of the speaker's cases, an infant, the starting point of an ordinary ileocæcal type was in Meckel's diverticulum which intussuscepted, and by traction on the small intestine started up an ordinary type of intussusception. As to the technic, he understood that Doctor Russell first did an enterostomy, and then removed the malignant tumor, a two-stage operation. On the right side the speaker was in the habit of doing a one-stage operation for carcinoma, except in the presence

of acute obstruction Where obstruction is present the technic of course is different In left-sided cases he still practiced resection and anastomosis in two or three stages by the Mikulicz procedure, whether obstruction was present or not, and with much satisfaction as regards operative mortality

CARCINOMA OF THE TONSIL AND ADJACENT TISSUES

DR FRANZ TOREK of New York, premised the presentation of two patients by saying that so much had been said about radium in the treatment of carcinoma of the oral cavity that a presentation of the subject from a purely surgical standpoint seems to be in order, especially as surgeons are learning to appreciate the dangers connected with the use of radium His remarks would be confined to one phase of the subject carcinoma of the tonsil, because its operative removal presents not only all the difficulties met in other parts of the oral cavity but probably some additional ones Thus far it had not been his good fortune to meet with a case of carcinoma of the tonsil in which the affection was confined to that organ, hence the heading "Carcinoma of the Tonsil and Adjacent Tissues" Thus, in the case of the two patients whom he had selected for demonstration, one recent case and one nearly four years old, the carcinoma had extended from the tonsil to the tongue, the soft palate, the pharynx, and the soft parts covering the lower jaw In one of the two, the recent case, the resection of the soft palate extended beyond the uvula, and not only the glossopalatine arch but also the pharyngopalatine arch on the affected side had to be resected

The lesion usually presents itself as a superficial carcinomatous ulcer with an exceptionally firm and immovable substructure As a rule the deep jugular lymph nodes are involved, especially those at the confluence of the common facial vein and the internal jugular They represent the first station for receiving the lymph from the mucous membrane of the base of the tongue and the anterior and lateral parts of the pharynx Though enlarged, they are not always carcinomatous, the pathologist occasionally reporting only a hyperplasia Then there is a group at the lateral side of the internal jugular vein, which receives the lymph from the mucous membrane of the lateral and posterior parts of the pharynx A third group is a chain along the jugular vein from the point where it receives the facial vein down to the place where the omohyoid muscle crosses its course This chain is sometimes very sparse sometimes denser, it usually receives the lymph from the preceding groups but sometimes directly from the lymph sources mentioned before, without first going through the other groups From this chain the lymph passes into the venous system at the junction of the jugular and subclavian veins A group of lateral deep nodes in the region of the scaleni and the trapezius and, finally, the supraclavicular group are not involved directly, but may be involved secondarily from one of the preceding groups If the lesion extends to the floor of the mouth, the submaxillary and submental lymph nodes may also be involved

The removal of the deep jugular lymphatic nodes at the confluence of the facial and internal jugular veins and the group of nodes to the outer side of

the internal jugular vein higher up is imperative, and it is advisable to remove also the chain along the jugular vein down to the point where it is crossed by the omohyoid muscle. In cases where the lesion encroaches on the floor of the mouth the submaxillary and submental nodes should be removed if they are enlarged. This was done in the two cases shown.

The operation begins with the lymph-node dissection, after which the external carotid artery is tied beyond its first branch, the superior thyroid, thus cutting off the lingual, ascending pharyngeal and ascending palatine arteries, all of which supply the new growth. The removal of the tumor may be done at the same sitting or may be postponed for a week or two, when the neck wounds will have healed. The supposed danger of spreading the new growth, when the lymph nodes, the normal barriers, have been removed, appears to be theoretical rather than actual, for after ligation of the external carotid one may usually observe a slight shrinkage of the new growth, its vital energy has temporarily abated.

Apparently hopeless cases sometimes turn out to be operable after good access is procured by proper exposure, a requirement which is met by bisection of the lower jaw, either median or lateral. The lateral bisection opens the oral cavity in closer proximity to the new growth, but the central cut through the jaw also gives very satisfactory access and has the advantage of being less likely to impair the function of deglutition, a rather important factor in guarding against aspiration pneumonia. Furthermore, if a lateral division is made, the muscles of mastication will tend to draw the shorter arm of the jaw up higher than the longer one which, in addition, is held down by the geniohyoid muscles. This tendency to displacement by the lateral division is met by making the cut through the jaw in an oblique direction, from above downward and forward, so that, when the short arm is drawn up, it will force the long arm to move with it. The speaker preferred the median incision and had practiced it regularly, with but a few exceptions.

The simplest form of anæsthesia is the colonic, but, to render it reasonably safe, the patient should never be deeply anæsthetized as the preservation of the reflexes at the larynx helps to serve as a safeguard against aspiration, which is a frequent cause of pneumonia. He gave four ounces of ether, no paraldehyde and no chloroform, preferring to support an insufficient narcosis by the occasional inhalation of a little chloroform, that drug being selected, if the cautery is to be used.

The procedure is as follows. The patient is placed in a position with the head hanging from the edge of the table, so that blood and secretions may run away from the larynx into the nasopharynx whence they are removed by a suction apparatus. The lip is divided in the centre and the incision carried down in the median line to the middle of the hyoid bone. At the chin the incision goes down to the bone, in the submental space only through the skin and superficial fascia. The vessels are secured. The soft parts covering the chin are held apart but are left attached to the bone. Before the jaw is divided, one or two pairs of drill holes are made, to serve for subsequent rewiring of the man-

dible The intact mandible affords a better support for the drill and better opportunity to estimate the correct alignment of the drill holes The site of these drill holes is always obscured later on by the overlying soft tissues, therefore it may be of advantage to mark the site in some way, for instance by the insertion of a piece of sterilized toothpick which after the bone has been sawed through, may be replaced by a thread If the thread is inserted so as to form a loop on the inner side, it will serve subsequently for drawing the wire through the drill hole The mandible may be divided either exactly in the middle or between the first and second incisors on the affected side, in which case the spine of the mandible with the insertion of the geniohyoglossus and geniohyoid muscles remains intact The jaw is divided with a Gigli saw A suture through the tongue serves to draw it in any given direction The two halves of the mandible are held apart by retractors The mylohyoid and digastric muscles on the affected side are divided near their insertion at the jaw While the tongue is being drawn toward the healthy side, the mucous membrane covering the floor of the mouth is divided well back to the vicinity of the lesion Now retraction of the jaw affords perfect access For excision of the new growth the knife may be used or the cautery He preferred the cautery, as the ensuing eschar insures against accidental implantation of tumor tissue into the wound If the base of the tongue is involved the resection begins at that organ, because, after the healthy part of the tongue has been released from the affected, infiltrated portion, it can be drawn out of the way much better than while it was still attached The rest of the affected part is then circumscribed by the cautery at a distance of at least one centimetre from the new growth, and the entire mass is removed in one piece Although the external carotid artery has been tied, it is necessary to watch for vessels, and these are secured promptly The operation being completed the jaw is wired, and the soft parts are sutured

The question of drainage has to be decided in each individual case If the lateral approach was selected, the suggestion of establishing a pharyngeal fistula by attaching the pharyngeal mucous membrane to the skin deserves consideration, for it offers the best safeguard against aspiration of secretions Later on, the fistula either closes spontaneously or is closed by the surgeon In cases attacked by the median approach the drains are placed at the posterior end of the submental wound, provided one drains at all He scarcely ever drained in these cases but depended upon natural drainage either forward through the open mouth or downward through the pharynx and œsophagus The patient is carefully watched after the operation till he is well out of the anæsthesia, and he is placed with his mouth directed more or less downward To guard against closure of the glottis due to sinking back of the tongue, the suture is allowed to remain in the tongue till the patient is well awake, so that the attendant may have a ready means to draw it forward, if necessary The function of deglutition is trained as early as possible, water being given The patient is also kept busy rinsing his mouth with permanganate of potash

When the wounds have healed, the resulting defect appears surprisingly

MYCOTIC CYSTS OF THE LIVER

small, as may be seen in the two cases presented. In both cases the lesion was prickly-cell epithelioma, in both cases it involved the entire tonsil and portions of the tongue, soft palate, pillars of the fauces, and mucous membrane of the lower jaw. In the more recent case the involvement of the palate and of the pharynx was quite extensive. In the older case the lymph nodes were carcinomatous, in the more recent case they were merely hyperplastic. In the older case, about one and one-half years after the operation, there developed a lymph-node metastasis on the opposite side, beneath the parotid gland. A packet of superficial lymph nodes was removed and, somewhat later, a deeper packet which had probably been overlooked at the previous operation. Although both of these were carcinomatous, no metastasis has occurred since then. At the site of bisection of the bone there occurs a superficial necrosis, in which case the spicules of bone usually find their way out. In the older case presented the necrosis was rather more extensive than usual, and the scar at the chin is depressed where the sequestrum was shed, moreover, the union between the two halves is ligamentous, not bony, but, nevertheless, firm and immovable. In the recent case the union appears to be bony. In some cases the wire has to be removed. If a fistula leading down to it persists, in other cases it becomes imbedded without any reaction.

MYCOTIC CYSTS OF THE LIVER

DR ALLEN O WHIPPLE, of New York, presented a girl, eleven years of age, who was admitted to the Presbyterian Hospital with an enlarged abdomen. The child complained of no symptoms but one year ago it was noted by her mother that her upper abdomen was increasing in size. This gradually increased and for past three months there had been noted a very distinct bulge in the upper abdomen. She had gained eleven pounds in the past year. There has been no definite pain but in the past three months there has been a distinct feeling of fulness in the upper abdomen after eating which has made her hesitate to eat full-sized meals. There has been no tenderness, no nausea or vomiting. There has been no urticaria or jaundice.

She was a rather thin, sallow, anæmic girl of eleven, shy but intelligent. There is some pallor of mucous membranes. The striking finding is the visible enlargement of the upper abdomen as shown by a marked bulge with three elevations or bosses in the epigastrium and right and left upper quadrants. There is no peristaltic wave, nor visible pulsation. On palpation no tenderness is elicited, but there is a definite fluid wave made out between the bosses in the right and left upper quadrants. These appear to be in an enlarged liver, the lower border of which comes well below the umbilicus on the right and to the level of the umbilicus on the left. The liver moves on respiration. On tapping the boss in the epigastrium a distinct hydatid thrill is noted by several observers. No fluid wave or shifting dullness is made out. Spine and extremities are normal. No œdema or urticaria is noted. Laboratory findings normal.

Flat abdominal film does not show either of the kidney outlines distinctly (due to enlarged liver). No shadows are present suggesting calcified nodes or calcified cyst wall.

October 4, 1928, she was operated upon with a diagnosis of hydatid cyst of the liver. When the peritoneum was opened, situated in the right and left lobes of the liver was a large cystic mass, the pearly white-colored wall of which could be seen through a thin layer of liver tissue. On incising through this the wall of a cyst was easily defined and was separated from the liver tissue.

easily. After plunging the trochar into the cyst some 1500 to 1800 cubic centimetres of a brownish-yellow, grumous fluid, of a thick puree consistency was aspirated. But this contained no hooklets or daughter cysts.

With the collapse of the contents by aspiration, using the technic of Alesandri, of Rome, it was possible to separate the first half of the cyst wall from the outlying liver tissue as easily as one does in hydatid cyst removal. But then the cyst wall appeared to merge more intimately into liver tissue so that soon it became impossible to draw out more of the cyst wall without much bleeding and tearing of liver tissue.

The cyst appeared to have two main compartments, one in the right, one in the left lobe, the former being the larger. On looking into the cyst cavity its anterior half, corresponding to the part that easily separated from living tissue, was smooth and of a pearly-white color, the cyst wall in this part measuring one to 0.5 centimetre in thickness. The deeper portion of the cyst appeared to have a lining of shaggy, broken-down liver tissue. There was no bleeding or flow of bile from the inside of the cyst cavity. The portion which merged with liver parenchyma bled easily, however, when attempts were made to separate it from the liver tissue. There was no evidence of ascites or portal obstruction. The gall-bladder and bile passages appeared normal. No evidence of other cysts in the abdomen was made out. The margins of the cyst wall were sutured to the abdominal wall and weak iodoform packing loosely applied to the subcutaneous tissue around the marsupialized cyst wall.

Three weeks later the patient was subjected to cystoscopy of the cyst cavity. It was possible by first irrigating the cavity and then filling it with normal saline to insert the cystoscope and get a very good view of the interior arrangement of the cavity.

It was made up of several pockets opening into the main cavity which had collapsed to a great extent. These side pockets had the appearance of diverticula as one sees them in the bladder. But the lining of the main cavity and its side pockets was made up of a variable amount of shaggy, fragmented pieces of necrotic liver tissue waving in the fluid very much as seaweed on the floor of the sea. No evidence of bleeding or bile-stained fluid was made out in the examination.

Pathological Report of October 8, 1928 Gross—Specimen is a piece of tissue removed from the wall of a liver cyst. It is roughly triangular in shape and measures two centimetres along its base and two centimetres along the other two sides. The wall is four millimetres in thickness. One surface is dark brown in color and covered by fibrous tabs. The reverse surface is gray in color and likewise covered by tiny fibrous shreds. On section, the tissue cuts with some difficulty and seems to be composed of dense, grayish, fibrous tissue.

Microscopic—A relatively anuclear fibrous connective tissue forms the major portion of the cyst wall. Many small lymphocytes are found in the interstices between the fibres. Covering one surface is a dense network of fibrin and enmeshed within it may be seen numerous polymorphonuclear leucocytes and a few small lymphocytes. Within the wall proper, a small amount of hemosiderin is found.

Diagnosis—Cyst of liver (infected)

The studies of the cyst fluid proved most interesting and the study of the mycology in this case, together with that of a cyst of the pancreas in a second patient and that of a very remarkable cystic condition of the pleura in a third patient, with animal experiments now under way, will be reported in full at a later date by Doctor O'Connor.

At present it may be stated that the cyst fluids have all been sterile to ordinary culture media for bacteria. They contained a vegetable or yeast-like

MYCOTIC CYSTS OF THE LIVER

organism, having some of the characteristics of the saccharomyces. But they appear to be a distinctive variety hitherto undescribed as a pathogen in man.

The patient continued to pour out large amounts of the glairy colorless fluid for some six weeks when the sinus had narrowed down to a track. This on injection with sodium iodide was reported as follows:

X-ray Examination of the Abdomen, October 30, 1928—Stereoscopic films of the abdomen with the patient supine, after the injection of sodium iodide into a sinus, shows the opaque material extending upward and to the right, apparently to a point beneath the anterior surface of the liver, relatively near the lateral abdominal wall. It is extremely difficult to tell whether the material goes into the liver or not. Assuming that the anterior margin of the liver is lower than the posterior it apparently does enter the liver itself. The margins of the shadow of the opaque material are very irregular. It seems to send projections off from the main channel upward and to the left. It is much wider about halfway from the sinus opening to the distal end of the channel than elsewhere. The channel seems to lie anterior to the hepatic flexure. A lateral view seems to show the channel extending straight backward, and its tip overlies the shadow of the liver. I still am not absolutely sure whether the opening enters the liver itself.

Because of the effect of iodides on blastomyces and actinomyces she was given large doses of potassium iodide and the cyst cavity was irrigated with weak iodine solution. Smears from the exudate showed that the vegetable organisms had largely disappeared, although they could be grown on Sabouraud's culture medium even when the cyst had decreased to a sinus tract. The child was discharged afebrile on the fifty-eighth day with a small sinus track.

Nine days later she returned complaining of pain and tenderness in her right upper quadrant and fever of two days' duration. She had felt well for a week after leaving the hospital. On admission her temperature was 104, pulse 140, and respirations 22. The child was evidently sick and in pain. She showed no jaundice or rash. Examination was negative save for the abdomen which was distended. The patient tends to tip body to the right as she lies in bed, and this gives a prominent bulge over the entire left side of the abdomen. In the right upper quadrant is a granulating wound three by six centimetres with a narrow sinus track about three millimetres in diameter, and which extends down into the liver substance about eight centimetres. A small amount of discharge of a cloudy, reddened nature comes from this with a few small, whitish particles that look like fibrin. The abdomen bulges slightly to the right and just above this granulating area, and is markedly tender just lateral to it. Liver percusses down to level of umbilicus. Marked tympany over left and lower abdomen. Liver felt at level of umbilicus. No other organs or masses felt. No herniæ.

Laboratory Findings—Red blood cells 3,600,000, hæmoglobin 60 per cent, white blood cells 14,000, polymorphonuclear leucocytes 72, lymphocytes 28. Blood culture—no growth.

She was observed for four days with elevated temperature and because of bulging right flank and right upper quadrant she was reoperated upon December 15, 1928. The findings proved most interesting in the light of the previous findings and the pathology of these peculiar mycotic lesions.

Situated in the anterior aspect of the enlarged right lobe of the liver, but below and to the outer side of the site of the previously evacuated cyst, was found a small cyst about one centimetre below the liver surface and about three centimetres in diameter. This cavity contained several cubic centimetres of a yellowish, thick fluid resembling pus. Situated beneath and posterior to this cavity was a second much larger cavity containing about 800 cubic centimetres of thin, turbid fluid.

Both these cavities had a distinct membrane or cyst-like wall which had much the same characteristics of the thick wall encountered at the first operation. So firm and thick were these walls that they offered a very real resistance to the insertion of the exploring needle. No bleeding and no bile was encountered in either one of these cavities. No free cysts or scolices were found in either cavity.

Procedure—An eight-centimetre incision was made one centimetre below and parallel to the right costal margin down through the peritoneum and to the free liver surface. The peritoneum was walled off by iodoform gauze, leaving a free surface of liver. This was punctured in an upward and backward direction for a distance of one centimetre when the pus-like fluid was evacuated. This cavity was then opened, a portion of wall removed for biopsy, and the exploring needle was then passed through the bed of this first cavity into the second larger one with the evacuation of the clear fluid mentioned. A large rubber tube was then inserted into the deeper larger cavity and this with the packing were brought out through the wound. The tube was sutured into the skin edges. Dry dressing.

The pathological examination of the cyst walls and the contents showed the same findings as at the first operation.

The large cavity decreased in size again, narrowing down to a track, but on her twenty-fourth day, after some temperature, she discharged a large amount of the same glairy fluid. After injection of this tract with sodium iodide X-ray examination of abdomen was reported as follows:

X-ray Examination of Abdomen, February 1, 1929—Films of the abdomen taken in the lateral position, and stereoscopic films in the anteroposterior position, shows the opaque solution to be situated in the medial and anterior aspect of the liver region. A portion of the opaque solution extends upward through a narrow channel into the anterior central portion of the liver. The outer cavity measures about eight centimetres across, and five centimetres in the anteroposterior plane. Under the fluoroscope the solution injected into the lower sinus was seen to fill another cavity, which was situated somewhat below and posterior to this upper larger one. No communication was found between them.

The child is still draining and the prognosis is problematical.

This case is reported to call attention to the cysts occurring in the solid organs and in the serous cavities that on ordinary culture prove sterile. We feel sure that many of these so-called sterile cysts or abscesses are of mycotic origin and that if the contents are carefully examined microscopically mycotic bodies will be found. A full report on this case and the cases with pancreatic and thoracic cysts from the standpoint of their mycology, animal inoculations and clinical features will appear at a later date.

DR WALTER M. BRICKNER, of New York, said that at the last meeting of the New York Surgical Society he had presented a woman with mycotic ulcers of the leg and mycotic pyarthrosis of the knee which later recovered promptly after irrigation of the joint.

DR JOHN SPEESE, of Philadelphia, said that Doctor Whipple's case called attention to the necessity for more careful and thorough cultural and microscopic studies in cases in which the focus of infection is difficult to demonstrate. Every surgeon has seen abscesses and other conditions in which some type of infection has seemed almost a certainty, and the laboratory report is returned as negative. This suggests, in some instances, that types of infection similar to the one reported by Doctor Whipple may have existed. While the echino-

coccus produces the most common form of parasitic cyst found in the liver in the human, other intestinal parasites may gain access to the liver and form cysts. In some of these cases, degeneration of the parasite had made it difficult to ascertain its exact nature, but this is not the case in the echinococcic cysts. The age of Doctor Whipple's patient suggests the possibility of congenital cystic disease which may involve the liver, pancreas or kidneys. In the cystic diathesis, however, the cysts are multiple and comparatively small in size.

DOCTOR WHIPPLE, in closing the discussion, said that because of the effect of iodine on mycoses this child was put on heavy doses of potassium iodide and the cyst had been irrigated with a weak iodide solution. In some cultures subsequently the organisms had disappeared, but later on they reappeared which makes the prognosis problematical.

FACTORS OF SAFETY IN RESECTION OF THE STOMACH FOR GASTRODUODENAL ULCERS

DR RICHARD LEWISOHN read a paper with the above title, for which see page 69.

DR GEORGE P MULLER, of Philadelphia, noted that Doctor Lewisohn did not lay stress upon gastrectomy as a treatment for duodenal ulcer. Doctor Muller feels that in view of the fact that at least 80 per cent of patients with gastro-enterostomy for duodenal ulcer enjoy good health and freedom from symptoms, the major operation should not be attempted routinely unless the surgeons are in a position to do a great many of these operations and thus operate with a mortality as low as that of gastro-enterostomy. Except for the complete cutting off of food traffic through the pylorus, the operation does not seem to have a good physiological basis.

The speaker prefers to subject a small percentage of patients to second operation rather than to perform gastrectomies upon the entire group. In several patients who have had recurrence of hæmorrhage from duodenal ulcer after gastro-enterostomy, he has had excellent results by completing a Bill-roth No. 2 operation at a second stage.

On the other hand, this figure agrees with Doctor Lewisohn's, in showing that pyloric ulcers and those involving the lesser curvature and antrum are proper subjects for primary resection. As a matter of fact, the speaker believes that all cases of gastric ulcer should be subjected to radical excision because no one clinically, roentgenly, or at operation can definitely exclude cancer in the case supposedly suffering from ulcer.

The speaker finds the greatest difficulty in attempting gastrectomy in cases of ulcer high up on the posterior curvature and frequently he must be satisfied with an excision, followed by a gastro-enterostomy.

All of these operations are dependent upon attention to the factors of safety for a low mortality. In the case of duodenal ulcer a correct diagnosis is a most essential factor. In the case of ulcer in the region of the pylorus, recognition of retention or obstruction is essential because such patients should be properly treated for a number of days before operation in order to lessen the effect of starvation, loss of chlorides and anæmia. Hence, gastric lavage, free use of salt solution with glucose and blood transfusion are essential.

RECONSTRUCTION OF COMMON DUCT NEW PROCEDURE

DR EUGENE H POOL, of New York, said that the numerous operations which have been attempted for the correction of a stenosed common duct are

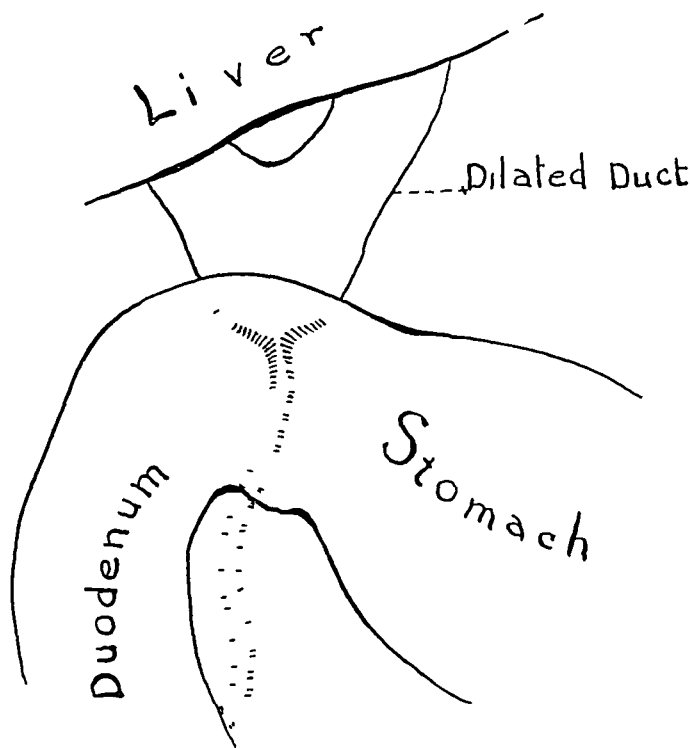


FIG 1.—Diagrammatic representation of dilated duct or bile reservoir above obstruction of common duct and its relation to the duodenum

all very serious procedures attended by high mortality and a large percentage of functional failures. It is unnecessary to review these procedures. The method which is to be described is the result of an attempt to find a simple and safe means of reestablishing a stenosed common duct, in cases where the gall-bladder has been removed.

The anatomical conditions in such cases are as follows:

First—The common and hepatic ducts above the obstruction are enormously dilated, forming a real bile reservoir.

Second—The duodenum is usually high, close to the liver and close to the dilated duct above the stricture.

Third—These structures are buried and united in a mass of solid adhesions.

The usual operations demand extensive dissection of the adhesions so as to expose the bile reservoir and displace the duodenum. After this prolonged dissection an anastomosis is made, the parts being brought together in much the same position in which they had been, and, to protect against leakage, an effort is made to reproduce the protective adhesions by apposition of omentum, etc.

His suggestion is to leave the structures in proximity and to leave the protective adhesions, to open the duodenum and do an internal choledocho-enterostomy. Such an operation should be simple, and short, with little danger of leakage. This is intended as a suggestion only, the technical details have not been worked out and perfected. Perhaps it will be impossible to do so. Yet in the one case in which the procedure has been attempted the results are promising. He therefore presented it for discussion.

A colored housewife, thirty-two years of age, entered the New York Hospital January 9, 1928, for relief of jaundice. Since 1911 she had been subject

RECONSTRUCTION OF COMMON DUCT

to frequent attacks of epigastric pain associated with jaundice. In 1927 the gall-bladder had been removed. After operation the pain and jaundice were relieved for five weeks. A swelling then appeared near the scar and jaundice recurred. The swelling burst, and bile was discharged, causing disappearance of the jaundice. Then the sinus closed and jaundice once more returned.

In October, 1927, the patient was operated upon for these symptoms. The operator reports that he found a severed common bile duct which he drained. A biliary sinus developed and the jaundice persisted. With this history the patient was admitted to the New York Hospital, January, 1928. She was a thin, colored woman, looking chronically sick and deeply jaundiced. The abdomen showed a sinus in the right upper quadrant from which bile was discharging. The icterus index was 39.0. Blood Wassermann negative. The urine showed much bile. Stools were light in color.

January 16, 1928, choledocho-enterostomy was performed. Anæsthesia—Ethylene-ether. Incision—Right epigastric mesial to the former scar. Duodenum identified but not dissected free. One and one-quarter inches from pylorus a transverse incision was



FIG. 2—Aspirating needle introduced through duodenal wall into bile reservoir

made in duodenum. A small aspirating needle was introduced upward through upper wall of duodenum, and blood was obtained. The needle was then passed upward and slightly outward and bile was obtained (Fig. 2). Methylene blue was injected and a clamp was passed along the needle and the orifice stretched, methylene blue coming out through the opening into the duodenum. Duodenal incision closed from above downward with three rows of chromic. Omentum sutured over this. Wound closed in layers without drainage.

The post-operative course was uneventful. The wound healed by primary union and the sinus remained closed.

She felt well for six months following discharge. Then afternoon temperature began, accompanied by increasing jaundice and occasional clay-colored stools, also loss of weight and gastric distress.

In spite of the ultimate failure of this operation Doctor Pool felt somewhat encouraged. In the first place the fistula closed, and although there was at first no pressure of bile from above on account of the fistula, the stoma functioned for some months. Second, the operation was too conservative. As in any new procedure one is apt to feel one's way uncertainly and as a result the new opening was not made sufficiently large.

She was readmitted to the New York Hospital November 13, 1928, deeply jaundiced. The urine contained bile, while the stool showed only a trace. Icterus index was 62.0

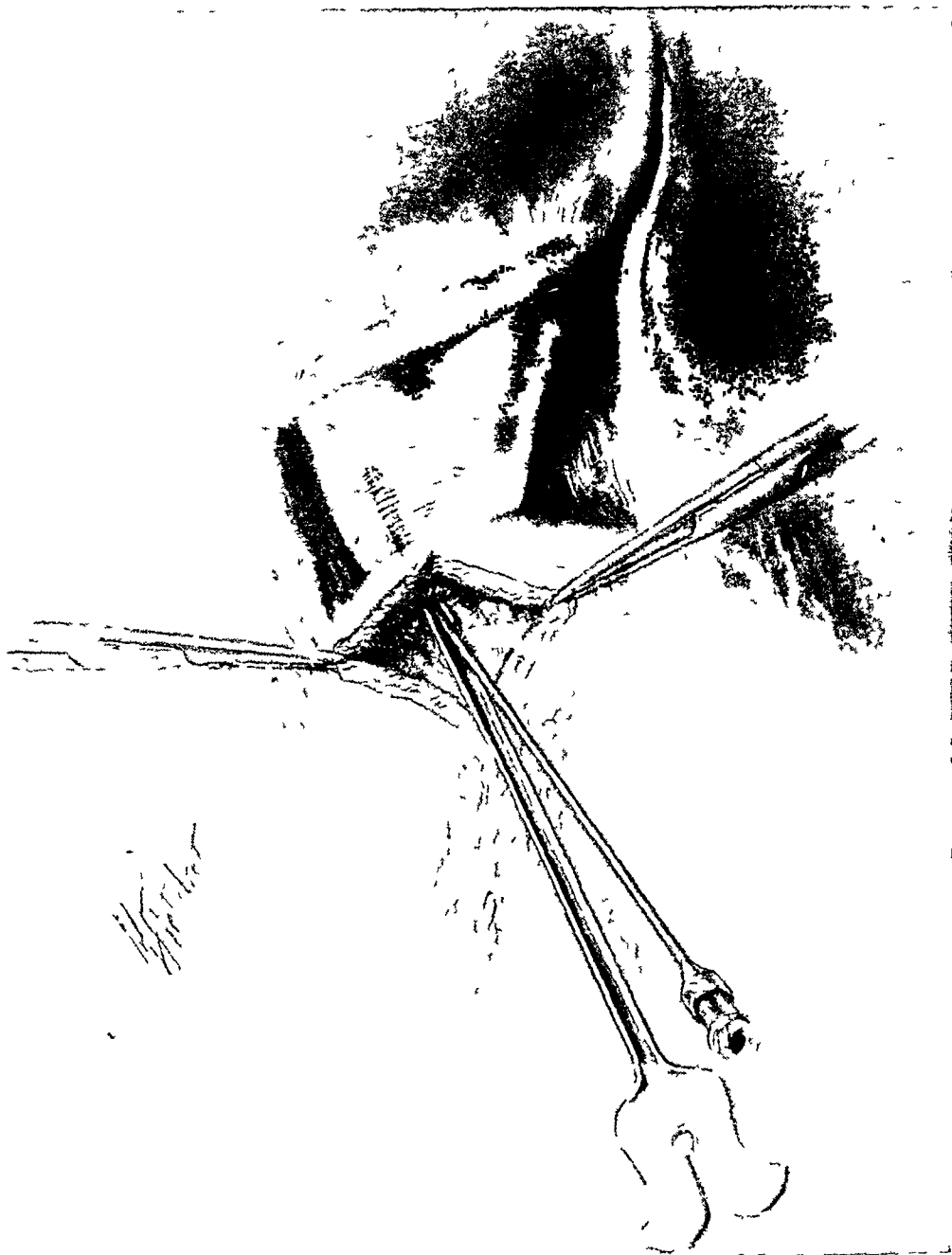


FIG. 3—Grooved director passed along needle

Operation November 26, 1928. Anæsthesia—Ethylene-ether. *Incision*—Right upper rectus excising the old scar. The duodenum was found to be closely adherent to the inferior surface of the liver. The adhesions were not detached. A vertical incision was made in the anterior aspect of the first portion of the duodenum. An aspirating needle was inserted through the superior

RECONSTRUCTION OF COMMON DUCT

wall of the duodenum toward the liver. At first blood only was obtained. The needle was withdrawn and directed upward and slightly outward. This time pale greenish-colored fluid was obtained. Leaving the needle in place a specially prepared grooved director was introduced along the aspirating needle.

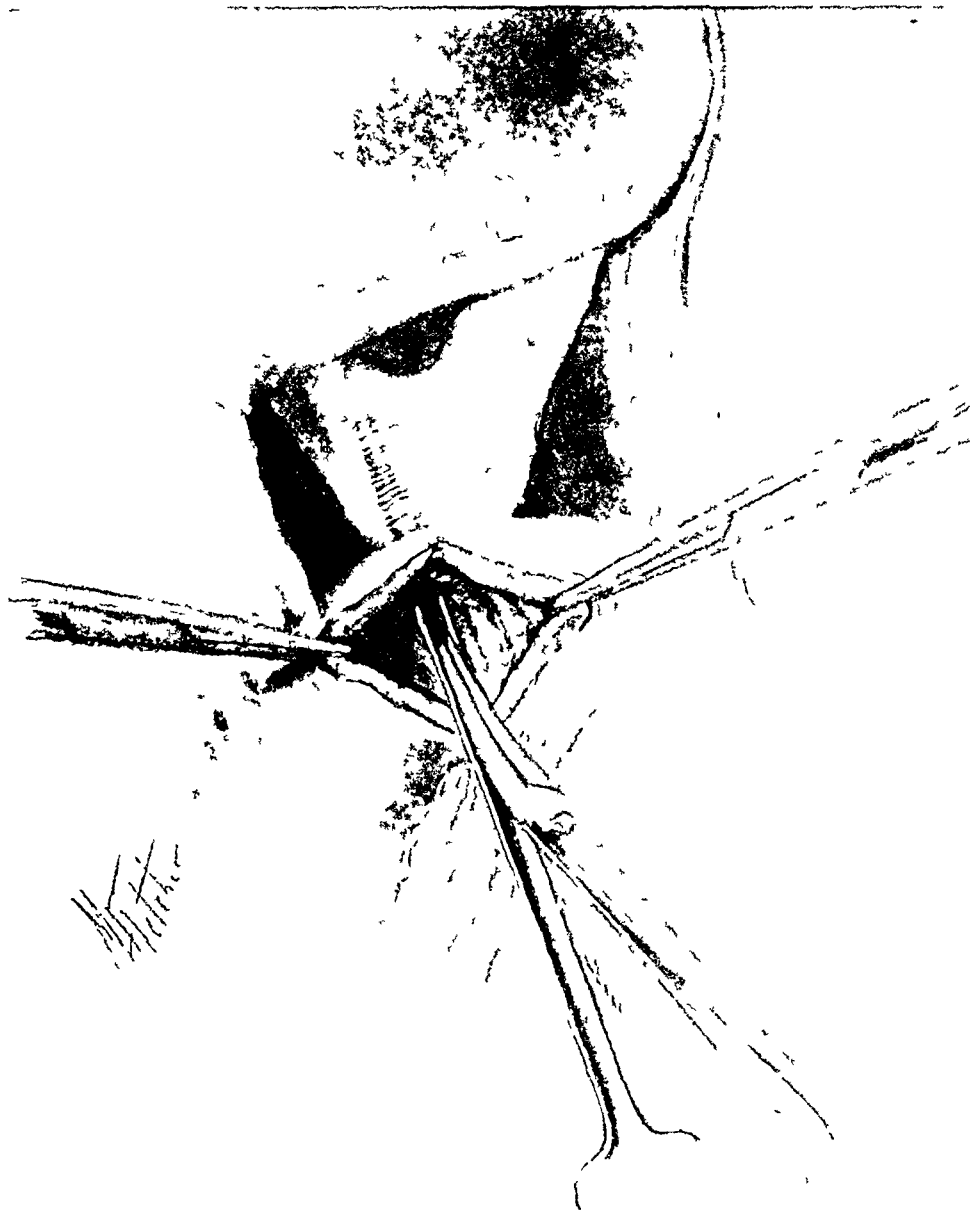


FIG 4—Artery clamp passed along grooved director

through the superior wall of the duodenum into the bile reservoir (Fig 3). There was a gush of bile and some purulent fluid. An artery clamp was passed along the grooved director and the orifice stretched (Fig 4). A No 26 French catheter four centimetres in length was introduced through the opening in the duodenum into the bile reservoir (Fig 5). This was fixed with one catgut suture. The opening in the duodenum was then carefully repaired with two layers of catgut. The wound was closed (Fig 6).

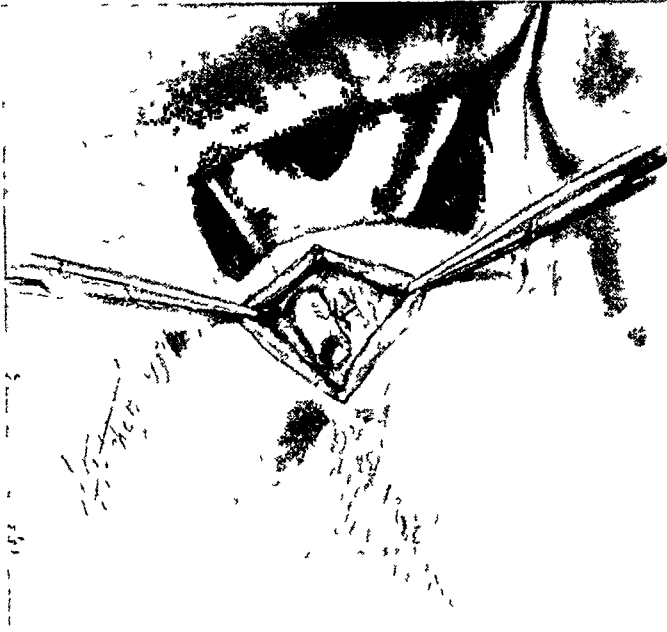


FIG 5—Tube in place

of the operation not yet established is the best way to prevent the anastomosis from contracting. It may be that this can be accomplished by sutures, but the reporter now feels that in another case he would introduce a tube somewhat constricted at the centre. The enlarged ends would prevent it from working back into the bile reservoir and from passing quickly into the duodenum. Of course if it did not pass into the intestine after a proper interval it might be necessary to remove it by operation. Danger from passing the small needle into the portal vein seems negligible. Apparently this was done at each operation without harm. Moreover, with the knowledge that the needle must be passed somewhat laterally and not directly upward, this embarrassment can probably be avoided in a subsequent case.

The post-operative course was smooth. The wound healed by primary union. The jaundice disappeared and by the time of discharge the urine was free of bile, the stools were normal in color and the icterus index had fallen to 160. The tube was passed per rectum on the eighth day. The general condition of the patient was rendered quite normal. She was discharged on the sixteenth day. At present, about three months after operation, her condition is normal, weight has increased twenty pounds, icterus index 11.

The technical feature



FIG 6—Duodenal incision sutured

RECONSTRUCTION OF COMMON DUCT

DR EDWARD J KLOPP, of Philadelphia, said that on one occasion he was obliged to anastomose the common hepatic duct with the duodenum following an operation early in 1925, when the gall-bladder was removed and the operating surgeon injured the common duct causing occlusion of the duct. Two months later he was reoperated and again occlusion of the duct followed. Late in 1925 the man came under Doctor Klopp's observation. He was then markedly jaundiced with enormous swelling in the upper abdomen. An interne made a nick in the skin and evacuated bile. After several weeks an attempt was made to relieve the constriction of the duct. A T-tube was inserted in the common duct extending into the duodenum. The man made a nice recovery and remained free from jaundice for three months, and then becoming jaundiced again returned for relief. At the operation the distal portion of the common duct was found to be replaced by scar tissue. It was impossible to anastomose the duodenum with the proximal portion of the common duct. Fortunately the common duct opening into the duodenum was found and a No. 10 catheter passed through it into the duodenum. Having failed previously to permanently establish the common duct it was decided to implant a larger catheter, whereupon a No. 24 catheter was selected. It was impossible to pass it through the duct opening even after dilatation with a duct forceps. The duodenum was opened following the suggestion of Duval and Richard the papilla dilated with duct-stone forceps. Even though they were unable to insert a No. 24 catheter the No. 10 was passed. The eye end of the No. 24 catheter was sutured in the funnel end of the No. 10. In that manner the larger catheter was passed without difficulty. The funnel end of the large catheter was placed in the proximal portion of the common duct, approximately four inches of the eye end of the catheter was cut off, and the catheter passed on down into the duodenum and the incision was closed. Omental structure in the vicinity of the duct was sutured over the reconstructed duct. The abdominal wound was closed with a Penrose drain. There was leakage of bile for the first five days following the operation, when it suddenly ceased and the wound promptly closed.

The man is now in fairly good health, working every day. A recent X-ray shows the tube approximately as it was placed in May, 1925. About a year ago he presented this case at the Philadelphia Academy of Surgery. He suggested then that it might be well to consider removal of the tube. Doctor Deaver remarked that he had a patient in whom he had used a short tube in an obstruction of the common duct and allowed it to remain five years when it was passed spontaneously. It is astonishing how long a foreign body can remain in a patient with little discomfort.

DR CHARLES F NASSAU, of Philadelphia, said that about seven years ago a patient came under his care who had a gall-bladder removed. The patient had jaundice and fever when he came to the speaker. After an operation which was extremely difficult and prolonged both ends of the common duct were exposed. The scar tissue was removed and the remaining portion of the duct was found to be normal. A piece of catheter was inserted to bridge the

gap between the ends of the duct which were about one inch apart. An omental graft was placed over the tube and the patient had no difficulty or recurrence of jaundice for about six years, at which time he died of carcinoma of the stomach. The operation was never reported but there is in existence an X-ray taken about three years after the operation which showed the tube *in situ*.



FIG 7—Diverticulum of duodenum

DIVERTICULUM OF DUODENUM

DR EUGENE H POOL presented a woman, sixty-two years of age who was admitted to the New York Hospital, October 23, 1928, because of repeated attacks of vomiting which had occurred for two and one-half years. First attack was in May, 1926. At that time she vomited green mucous material, no blood. Vomiting continued for one week. She had another attack of vomiting four months later lasting for several days and another attack the following month which lasted only one day.

There followed a period during which she was well. She then had three similar attacks in November and December, 1927, and one in June, 1928. Each attack of vomiting was preceded by belching gas and epigastric distress. Following the attacks she lost her appetite and felt exhausted for several weeks.

DIVERTICULUM OF DUODENUM

D¹ Walter Niles, who saw her first in June, 1928, reports that June 14, 1928, her urine contained a large amount of sugar, as well as a marked reaction for acetone. There was no diacetic acid, there was a faint trace of albumin and numerous hyaline and granular casts. On June 15 her blood sugar was 186 milligrams per 100 cubic centimetres of blood, June 16 her blood chemistry was as follows

Urea Nitrogen	18	mgms	per 100 c c	of blood
Non-protein Nitrogen	35.6	mgms	per 100 c c	of blood
Uric Acid	4.4	mgms	per 100 c c	of blood
Sugar	136.95	mgms	per 100 c c	of blood
Chlorides	468.75	mgms	per 100 c c	of blood
Creatinin	1.879	mgms	per 100 c c	of blood

June 17 and succeeding days there was no glycosuria.

Her next attack began on September 27, 1928. There was again a large amount of sugar in the urine with considerable acetone and diacetic acid. The sugar persisted for four days, although the acid bodies disappeared in two days. Her blood sugar on September 28, 1928, was 198.

Faecal examinations made during the attack showed large amounts of mucus and many undigested starch cells. There were no other evidences of pancreatic insufficiency. Lost twenty-five pounds during past two and one-half years.

February 13, the abdomen was opened. Adhesions were freed between the gall-bladder and the duodenum. The colon was displaced downward and the duodenum mobilized. The duodenum and head of pancreas



FIG. 8—Diverticulum of duodenum showing fluid level

were then lifted mesially like a trapdoor. The diverticulum was then identified closely opposed to the posterior aspect of the head of the pancreas. It was collapsed but measured about two inches in diameter. It was, of course, retroperitoneal. Four or five large thin-walled veins lay on its surface. These were ligated and divided. The sac was then readily dissected free. Its wall was very thin, its neck two centimetres in diameter was situated at the lower part of the mesial aspect of the descending duodenum. The diverticulum was excised a short distance from the duodenum. The orifice was repaired transversely with three rows of chromic gut. Extreme care and thoroughness were necessary on account of the inaccessibility and the retroperitoneal position. When the repair was completed it was felt that the lumen of the duodenum was so

much encroached upon that obstruction might occur. Therefore a posterior gastrojejunostomy was done. The wound was closed without drainage.

Post-operative course entirely smooth. Patient discharged twenty-one days after operation. She has had no further complaints, eats everything, general health good. No sugar has been noted in the urine. February 3, 1929, blood sugar 125 milligrams per 100 cubic centimetres of blood.

DOCTOR POOL thought this case to be of interest, first, on account of the unusual situation of a large diverticulum, it lay posterior to the head of the



pancreas. Second, because of the peculiar symptoms, notable periodic attacks of vomiting with hyperglycæmia and glycosuria presumably due to pressure by the dilated diverticulum upon the pancreas or its duct. Third, these disturbances were cured by operation.

DR JOHN H GIBBON, of Philadelphia, said that there were three types of diverticulum of the œsophagus

FIG 9.—Diverticulum of duodenum, excised

First, that due to perforating ulcer which is quite common. Second, that due to a probable congenital defect in the musculature which results in a herniation of the mucous membrane, and resembles very closely, he thought, in development and pathology, a diverticulum of the œsophagus. To this class Doctor Pool's case belongs. Of this class Doctor Gibbon has seen no case.

The third type resembles the Meckel's diverticulum found usually in other parts of the small intestine. Slides were then shown illustrating an unusual case of the latter type which was operated upon at a meeting of the Clinical Society of Surgery at the Pennsylvania Hospital last fall. The diverticulum in this case was very long, and when filled with barium, changed its shape, indicating a definite musculature. On opening the abdomen the diverticulum, about the size and shape of a thumb, came off from the anterior wall of the duodenum, and the communication between the diverticulum and the bowel corresponded to the width of the former. The extremity of the diverticulum was free, which accounted for the different positions in which it was seen in the X-ray plates. Its removal, of course, was a simple matter. Doctor Pool's case was a very much more serious one, and one in which successful removal was very much more difficult.

DR FRANK S MATHEWS referred to a case, somewhat like Doctor Pool's, in which, in advance of operation, he thought he was dealing with a case of common-duct stone. The X-ray showed a shadow to the left of the duodenum which was interpreted as indicating that bismuth entered the common duct. At operation the common duct was drained, but there were no stones. At

SPREAD OF BACTERIA

autopsy the patient was found to have multiple abscesses in the pancreas. A diverticulum of the duodenum, apparently congenital, lay in contact with the pancreas and opening beside the common duct. It was thought that this diverticulum might be related etiologically to the suppurative pancreatitis.

THE SPREAD OF BACTERIA FROM THE GALL-BLADDER TO THE LIVER

DR WALTON MARTIN read a paper with the above title, for which see page 47.

DR I. S. RAVDIN, of Philadelphia, said that he was in Edinburgh at the time that Dr. A. L. Wilkie did his work. There were several very interesting factors in connection with it. In the first place, in the majority of instances in which the bile was cultured, it was found to be sterile. When a culture was made of the wall of the gall-bladder with the mucosa intact, it was practically always sterile, but when the mucosa was removed in a large number of instances Doctor Wilkie was able to obtain a positive culture which coincided with the culture he obtained from the cystic lymph gland. The organism which he recovered he believed to be similar to the Rosenau streptococcus which has a "specific affinity" for the gall-bladder. Whether the gall-bladder is primarily infected, or is infected secondary to hepatitis is questionable. It is definitely known that hepatitis may result from cholecystitis and that the reverse process may likewise take place. Whether the mechanism of the infection is lymphatic in its origin is questionable. It is exceedingly difficult to demonstrate a continuation of the gall-bladder lymphatics into the liver substance.

Doctor Ravdin has tried this by three methods—the use of colloids, by air injections of the lymphatics, and by the use of carbon particles. Although the gall-bladder lymphatics fill out exceedingly well, and the material enters the glands around the head of the pancreas, one does not find them passing back into the liver. It appeared to him that although there is no doubt of the relationship between hepatitis and cholecystitis, that it has not been shown beyond any doubt that this connection is lymphogenous.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

STATED MEETING HELD FEBRUARY 27, 1929

The President, DR FRANK S MATHEWS, in the Chair

THE CURE OF SPONTANEOUS PNEUMOTHORAX

DR HOWARD LILIENTHAL presented a young man who, at the age of nineteen years, in December, 1927, "caught cold" and on February 15, 1928, while attending a college lecture experienced sudden thoracic pain and great dyspnoea. Pain lasted a few minutes but the dyspnoea and slight cough persisted. X-ray pictures revealed an extensive right pneumothorax.

Doctor Lilienthal first saw him April 20, 1928, and on testing his vital capacity found it to be only one and one-half litres. Blood pressure was 120/80, his weight about 130 pounds. The X-ray picture revealed complete pneumothorax under considerable tension for the mediastinum was pushed far toward the left. No treatment was advised in the hope that, as in other cases under his observation, the air might be absorbed. Two or three nights later Doctor Lilienthal was awakened by a telephone call and the report of dangerous dyspnoea and deep cyanosis. The patient lived in Brooklyn and realizing that prompt action was necessary Dr H S Fischer was requested to aspirate at once. This was done with immediate relief and then Doctor Fischer inserted a tube with the aid of a trocar and cannula and applied a flapper valve. The lung, however, did not expand although there was immediate and apparently complete relief. Empyema developed and finally he entered Mt Sinai Hospital where June 19 Doctor Lilienthal drained the cavity by an intercostal incision and placed a large tube with fingercot valve in the opening. The pus was so thick and there were so many fibrin coagula that Carrel-Dakin treatment was employed. Under the flapper valve suction the lung expanded and became adherent everywhere to the chest wall resulting in a final complete cure. The speaker had not previously heard of the deliberate production of an empyema in cases of this kind, but was convinced that the effect of the subsequent adhesive pleuritis is curative in cases of pneumothorax. At any rate it promises freedom from dangerous recurrence because the adhesions will prevent extreme deviation of the mediastinum.

He would not regard as spontaneous a pneumothorax from a punctured lung due to a fractured rib. Spontaneous pneumothorax in the sense he wished to convey did not include the condition occurring when a tuberculous cavity breaks into the chest. This is tuberculous pyopneumothorax. The cases he spoke of are those which are sometimes seen in children with whooping cough in which tiny congenital blebs break and leak air into the pleural cavity. Of course it would not be wise to give the patient empyema to cure a pneumothorax which will cure itself but if it won't and there is danger on account of deviation of the mediastinum then, he felt it is a good thing to have in mind.

EARLY BANT'S DISEASE—SPLENECTOMY

DR CHARLES GORDON HEYD presented a boy, nine years of age, born in Italy living the last four years in New York City. The patient entered the

EARLY BANTI'S DISEASE—SPLENECTOMY

New York Post-Graduate Hospital, to the service of Dr. M. C. Pease, January 30, 1929, the complaint being an anæmia and a mass in the abdomen. The parents state that three years ago the patient began to get pale and a small mass was felt in the abdomen. The mass was discovered quite accidentally and aside from the anæmia there were no other symptoms. There has never been any fever associated with the discovery of the mass. Constipation, however, has been a prominent symptom. He was a moderately well-developed, poorly-nourished, anæmic, white-skinned boy, who appeared markedly ill. There was a marked degree of caries, chronically infected tonsils and a dirty condition of the mouth in general. The heart and lungs were not noteworthy. The abdomen appeared distended, tense, with prominent superficial veins. Occupying the entire left side of the abdomen from beneath the costal arch down to the pelvis was a mass that had the general physical characteristics of an enlarged spleen.

X-ray examination showed a large, soft-tissue tumefaction in the left abdomen. The lower pole of the enlarged left kidney was also noted. Wassermann was negative, and the blood examination on admission showed a leucocyte count of 2700, erythrocytes 3,350,000, hæmoglobin 60 per cent, and polynuclear neutrophils 73, eosinophiles 3, basophiles, transitionals 1, mononuclear leucocytes 8, small lymphocytes 8, large lymphocytes 6. The red cells showed a uniform tendency to microcytosis.

The bleeding time was five minutes, coagulation time, four to five and a half minutes. No undue fragility of the platelets.

Date	Platelets	Erythrocytes	Hæmoglobin	Leucocytes	Polynuclears	Comment
Jan 31, 1929	70,350	3,350,000	60	2,700	73	Bleeding time, 5 minutes Coagulation time 4-5½ minutes Microcytosis
Feb 4, 1929	143,200	3,250,000	62	3,700	73	Blood transfusion 400 cubic centimetres whole blood
Feb 6, 1929						
Feb 9, 1929	Splenectomy					Microcytosis
Feb 13, 1929	273,600	3,830,000	70	11,000	79	

Urinary examination showed nothing noteworthy.

The clinical diagnosis was made of infantile splenic anæmia, with Gaucher's disease as a possible second diagnosis.

February 9, 1929, the abdomen was opened through the left upper rectus incision. The spleen was grossly about ten times the normal size and there were many dense adhesions between the spleen and the peritoneum over the left kidney. The spleen was hard, leathery and of a dark blue-gray color. At the superior pole were two large adventitious blood vessels apparently coming from the diaphragm and at the inferior pole an additional aberrant vessel was noted. The gall-bladder was negative to both palpation and observation. In contrast to the spleen the liver appeared as nearly normal as seemed possible. There was no hepatic enlargement. There was no fibrosis and no hepatitis nor adhesions about the liver or gall-bladder. The lymph glands along the under surface of the transverse colon were somewhat pigmented and slightly hyperplastic. The remainder of the abdomen not explored. The operation consisted of a more or less typical splenectomy, during the course of which some venous oozing was encountered in the tail of the pancreas necessitating two mattress sutures through pancreatic tissue. The abdomen was closed in the usual anatomical fashion without drainage.

The pathological report by Doctor Alter showed a spleen weighing 565 grams. The capsule is irregularly thickened and covered with fibrous adhesions, particularly at the

upper pole At the hilum larger vessels are seen covered by somewhat œdematous blood clot On section a uniformly pale parenchyma is seen It is firm in consistency Some of the smaller arteries seem to be plugged with black blood clot

Section of the spleen shows loss of lymphoid tissue The follicles are small A striking feature is the extensive hæmorrhage in the trabeculæ There are also some hæmorrhages in the sinuses and follicles The sinuses form glandular structures which are lined by rather high endothelial cells The sinuses are separated by a cellular stroma The cells are mostly fibroblasts There are also lymphocytes and polynuclear leucocytes Old blood pigment is also seen in the sinuses Fat stains show some fat in the trabecular stroma and endothelial cells *Pathological diagnosis*—Early Banti's Disease Doctor Alter makes further comment that this type of fibro-adenosis usually occurs in conjunction with a similar liver lesion

The interesting feature of this case is the fact that for at least three years, the parents knew the child had a mass within the abdomen During this period the child was carrying on functionally in fairly good condition with always, however, a constant anæmia It seemed wise to remove this boy's spleen as a means of bringing him back to a more normal individual The pathological examination of the spleen still leaves some doubt as to whether they were dealing with one of the manifestations of early Banti's disease, or a splenic anæmia of undetermined pathology or finally, a variant of Gaucher's condition

ŒSOPHAGEAL DIVERTICULUM

DOCTOR HEYD presented also a man, sixty-one years of age married, born in Germany and has resided in the city of New York for the past forty years His present complaint began with difficulty in swallowing, eleven years ago At first the patient noticed "catching or holding" of his food just below the midpoint of the neck For the last eighteen months it has become continuously and persistently worse and from time to time the patient has vomited back his food, which seems to come from somewhere in his neck The inability to swallow has become increasingly more marked The patient has found that fluids usually go very much better than solid food He has lost forty pounds in weight

The man presented a rather extreme degree of emaciation, and a well-defined anæmia Except for the X-ray findings of the œsophagus with a barium meal there was nothing noteworthy to be observed On X-ray examination a diverticulum was to be seen arising from the posterior and left lateral aspect of the œsophagus at about the level of the cricoid cartilage The sac extended downward and backward and somewhat to the left between the posterior wall of the œsophagus and the anterior surface of the cervical vertebræ When filled with barium the diverticulum extended well below the upper level of the manubrium and in its gross outline was approximately the size of a Bartlett pear

The complications that may be expected in operating for diverticulum of the œsophagus are (1) Aspiration pneumonia, (2) mediastinitis, (3) hæmorrhage, (4) fistula, (5) recurrence In Stetten's sixty cases the operative mortality was 16.6 per cent and it is interesting to recall that Zenker and Siemssen in 1877 expressed the hope that œsophageal diverticula might be cured by surgery Sepsis and pneumonia are the most frequent causes of death Pneumonia can be to a large extent prevented by using a local anæsthesia, or ethylene gas, by drainage of the diverticulum of its putrid contents through an œsophagoscope, and by avoiding pressure on the diverticulum during the course of the operation whereby the septic material might be forced into the lungs If œsophageal leakage occurs it will follow along the fascia in front of the ver-

tebral column and advance into the posterior mediastinum, a complication of great lethal potentialities. Hæmorrhage should be obviated during the course of the operation and afterward by the absence of drainage tubes. Fistula and recurrence are fortunately very rare and to a large extent can be prevented by a precise operative technic and the use of the Levine tube after the excision of the diverticulum.

The patient was operated upon by the two-stage method. The first stage was performed November 17, 1928. The patient was anæsthetized with ethylene gas and an incision made in the left side of the neck, at the level of the hyoid bone, downward along the anterior border of the sternomastoid muscle. The belly of the left omohyoid muscle was divided, the left lobe of the thyroid pulled upward and to the right. The diverticulum was readily recognized and by blunt dissection freed, except at its neck where it joined the œsophagus. The sac was brought out through the upper portion of the incision in almost a direct line laterally from the cricoid cartilage and sutured intact into the skin wound. The skin was closed with Michel clamps. Following the first stage the patient was able to swallow fluids with very little difficulty. At the end of forty-eight hours he was given solid food, which passed readily. He was somewhat disturbed by air passing into the diverticulum and ballooning it out on the neck. On the fourth day a small incision was made in the sac to deflate it by allowing the escape of air. One week later the patient was anæsthetized by ethylene gas and the first incision in the neck was opened up. The sac was readily freed and excised close to the œsophagus. The neck of the sac was ligated with No. 2 chromic catgut and inverted into the œsophagus much after the fashion of the inversion of an appendix. Two mattress sutures of No. 2 chromic catgut were also applied after the inversion. The neck wound was closed in anatomical manner without drainage.

A Levine tube was passed through the nose into the stomach and for four days the patient was not allowed to swallow. At the end of the fourth day the Levine tube was removed and the patient allowed soft diet. The skin wound healed readily and with a very minor degree of infection. The patient was discharged from the hospital on the fifteenth day. Since his operation he has been able to eat anything he desires and has gained some twenty-two pounds in weight. At the present time his only complaint is some slight fixation in the neck, in the region of the wound.

DR DEWITT STETTEN said he saw his first case of œsophageal diverticula twenty years ago. He believed that the condition was not such a very uncommon one as it was thought to be at that time. His paper, published in 1909, was one of the earliest publications on the subject in this country and the following year the Mayo Clinic published six cases. Since that time the Mayo Clinic has reported over thirty cases and of course quite a number of cases have been reported on elsewhere. Doctor Stetten's views on the surgical handling of these cases have undergone some change. At the time of his publication, owing to the high mortality, which was something over 16 per cent, he thought it was advisable to do a preliminary gastrostomy for most of the cases were elderly people who were much undernourished from partial starvation, and those that did not die of infection and mediastinitis died of pneumonia. Today he believes that a gastrostomy is unnecessary and he has also come to the conclusion that

the two-stage operation, as described by Doctor Heyd, is the best and safest procedure. His last case he saw about four years ago. The patient was a very much undernourished man of seventy on whom he performed the two-stage operation similar to that described by Doctor Heyd. He used local anæsthesia, under which the operation can be done very easily. The patient made an uneventful recovery. The operation is really a relatively simple one, the main point being the identification of the sac. He was glad that Doctor Heyd emphasized the use of the duodenal tube to prevent leakage from the suture line, which can occur even in the two-stage operation. The œsophageal fistula may take a long time to close and may interfere with nutrition of the patient. Doctor Stetten believed that the duodenal tube should be passed in the interval between the first and second stage, because it is unnecessary before the first stage and very difficult to pass as the tube tends to coil up in the diverticulum. After the first stage, when the diverticulum has been drawn away from the œsophagus out into the wound, the tube will pass readily and then active swallowing can be eliminated after the second stage until danger of leakage has passed. If the tube has not been used as a preliminary measure before the second stage and an œsophageal fistula does form the use of the tube then is the best and most rapid way of causing the fistula to heal.

DR WALTER A. SHERWOOD thought that the principal danger in operations for œsophageal diverticula to be infection of the mediastinum. A patient consulted him recently who had been strongly urged to submit to an attempt to invert and remove a diverticulum through an œsophagoscope. This form of treatment is being quite widely advocated by a group of surgeons specializing in the nose and throat who have had special training in the use of the œsophagoscope. In a number of instances in which such a procedure has been attempted the wall of the diverticulum has been perforated and the patient has promptly died of mediastinitis. Doctor Sherwood felt that a note of warning should be sounded against such an obviously dangerous and unsurgical method of dealing with this condition.

DR HOWARD LILIENTHAL said that before using the œsophagoscope the one who is going to use it should examine the structure of a diverticulum of the œsophagus. As Doctor Heyd has explained, the diverticulum is apt to be extremely thin and very friable and the danger of operation manipulation from within is greater than operation from without. However there is another operative procedure which may be described as the first stage of the operation Doctor Heyd has done and letting it go at that. If the patient is very feeble and one is afraid to do any more a comfortable existence is possible with this first stage only. Cases have been reported in which the sac was carefully dissected out, brought up into the neck and fastened there leaving the open part of the diverticulum lowest. It is said that cases treated in this way give excellent clinical results and eliminate the risk of mediastinitis.

DR ALFRED V. MOSCHCOWITZ stated that in a recent case he was tempted to do a one-stage operation on what he believed to be a particularly suitable

OSTEOGENETIC SARCOMA OF THE HUMERUS

case of diverticulum of the œsophagus. In this particular case, local anæsthesia was used and the operation was entirely painless.

Doctor Moschowitz has found that diverticula of the œsophagus have a peculiar yellow color which is sufficient to render their finding very easy. He has also found that the finding of the diverticulum can be materially aided by a competent œsophagoscopist who will introduce a light at the right moment into the œsophagus. This diverticulum was very small and Doctor Moschowitz was able to obtain a very good inversion suture, drainage with a small bit of rubber dam. Within ten days' time, the wound had apparently completely healed, but it broke open and started a leak. The leak was very small but it was sufficient to make the feeding of the patient very difficult and he gradually ran down in spite of the introduction of a duodenal tube for the purpose of feeding. In the course of time, the patient became disgusted with surgery and finally he was discharged with a small leak and sent back to his home town. When the patient reached his home, less than forty-eight hours after his discharge, Doctor Moschowitz received a telegram that the diverticulum was closed. This has remained closed ever since that time. The patient was seen by Doctor Moschowitz about two months ago, at which time, he enjoyed the best of health.

DR FRANK S. MATHEWS said that when operating on an œsophageal diverticulum in a woman, eighty-four years of age, under local anæsthesia, he had found his only difficulty depended in the friability of the sac. On delivering it the sac was torn extensively. Packing was introduced about it and the whole sac sloughed, leaving a fistula which closed spontaneously. Hence there was no second stage to the operation.

DOCTOR HEYD, in closing, said he had been surprised how easily the operation could be performed. The sac was readily recognized and the moment that it was transfixed to the neck, swallowing could readily take place without back flow into the diverticulum. It would seem that many of these cases of œsophageal diverticula are not recognized and that the ordinary surgeon approaches them with fear and trepidation. The two-stage operation eliminates practically all fear of infection of the mediastinum. The Levine tube is a great aid in neck surgery as it permits feeding without the necessity of the patient swallowing.

OSTEOGENETIC SARCOMA OF THE HUMERUS

DOCTOR HEYD presented a man, twenty-three years of age, born in New York, who entered the New York Post-Graduate Hospital December 11, 1928, complaining of swelling of the left arm, with constant pain of a dull heavy character of three weeks' duration. About a month ago he noticed that the left arm above the elbow was larger than the right, and there was considerable soreness. Condition remained unchanged for about two weeks. The arm rapidly increased in size and became very tender. Physical examination was unimportant except for the left arm. X-ray of the thorax showed little evidence of pathological change. There was some slight right bronchial thickening but no evidence of parenchymatous infiltration. X-ray of the left arm and shoulder showed a fusiform tumor of osseous origin, occupying the mid-

dle of the left arm. There was periosteal elevation with irregular subperiosteal bone proliferation and slight cortical destruction, suggesting periosteal osteogenetic sarcoma.

Clinical examination of the left arm showed a fusiform neoplasm occupying the entire left arm from the shoulder to the elbow. On palpation the tumor seemed to be due to bony growth but there was no egg-shell crackling. There was a peculiar red-blue blush over the entire arm and the superficial veins were dilated.

Disarticulation of the shoulder was performed under ethylene anaesthesia December 12, 1928. The first incision ligated the axillary artery in the third portion of its course at the inner border of the coracobrachialis muscle. The larger nerves were pulled downward, injected with one cubic centimetre of absolute alcohol and divided. Following this the disarticulation of the left arm was made at the shoulder. After the ligation of the axillary vein the only vascular anastomosis was between the acromiothoracic artery anastomosing at the anterior circumflex. Bleeding was unusually well controlled and offered no difficulties. The post-operative course was uneventful.

Examination by Doctor Alter showed a specimen consisting of the left arm which was disarticulated at the shoulder. It was very well developed. The hand and lower forearm showed nothing unusual. The skin showed nothing unusual. About the middle of the humerus there was a spindle-shaped swelling. On section a great deal of blood escaped from irregular cavities. There was a growth, thirteen centimetres in length, which seemed to spring from the periosteum of the humerus. It occupied about the middle third of the arm. The growth extended to within six centimetres of the neck of the humerus. The tumor was very soft, friable and broke down under the least pressure. Throughout the muscle tissue there seemed to be a capsule in some places, but free invasion was also seen. There was a great deal of bony tissue throughout the muscle. The microscopic examination showed a neoplasm which consisted of large polyhyal cells. The nuclei were mostly elongated, vesicular. Mitotic figures were exceedingly numerous. There were numerous giant cells of the endothelial type. There were very rich blood vessels everywhere. There were also large cavernous spaces lined by one layer of cylindrical cells filled with red blood cells. The growth invaded the bundles of striated muscle very extensively. *Pathological diagnosis*—Telangiectatic periosteal sarcoma of the humerus. *NOTE*—This is one of the most rapidly growing neoplasms.

The patient made an uneventful recovery and was discharged from the hospital on the tenth day after operation.

DR HOWARD LILIENTHAL said that in all cases of sarcoma the patients should be treated post-operatively by a course of Coley's mixed toxins. He was convinced from a long, careful experience that this has a great deal to do with not only the cure of inoperable cases but with the prevention of recurrence. He strongly urged that all these cases be submitted to that treatment.

ACUTE DIFFUSE HÆMORRHAGIC PANCREATITIS

DR JOHN E. JENNINGS presented a woman, twenty-seven years of age, the mother of three children.

Thirty-six hours before her admission to the Brooklyn Hospital, January 17, 1922, she was suddenly seized with pain in the epigastrium which was severe and boring in character, radiating to the back. Nausea and vomiting accompanied the pain and persisted. The pain was not relieved by hypodermic injections of morphine and increased in severity. There was a record of two

CHRONIC PANCREATITIS

previous attacks of similar character but of less severity. The first, three years, the second, six weeks previous. With the last a slight and transient jaundice occurred. There was also an irregular story of digestive disturbance. No other serious illnesses and no operations. She was a well-nourished young woman whose abdomen showed marked tenderness in the epigastrium and right upper quadrant. No masses could be made out, rigidity was moderate. Temperature 99°, blood count 20,350, leucocytes 90 per cent polymorphonuclear.

A diagnosis of acute pancreatitis was made and an immediate section made. There was free fluid in the peritoneal cavity and turbid serum stained with blood. The gall-bladder was somewhat thickened and a single stone was palpable within it. The pancreas was enormously enlarged, the head four inches across and two inches thick, the body and tail were proportionately thick, purple and engorged with blood. The duodenum was thickened and oedematous. The gastrocolic omentum was separated and the body of the pancreas punctured with a Kocher clamp. Copious alarming hæmorrhage ensued which, however, ceased in a few minutes with evident shrinkage in the gland. Puncture repeated further to the left with the same effect. A third puncture was made in the head of the pancreas beneath and to the right of the duodenum. At the end of this procedure the head and body of the pancreas were found to be about two-thirds their former size. Cholecystostomy with removal of one stone. A suprapubic stab drain of a raffia dressed tube was set in the pelvis. Drains also set near the point of puncture in the capsule of the pancreas. The gall-bladder was drained and the abdomen closed in layers as usual with continuous chromic catgut, interrupted chromic, silkworm-gut stay sutures and silk.

Her convalescence was stormy. A rather active peritonitis was, however, finally controlled and she was discharged from the hospital on the fortieth day after operation. Several attacks of cholecystitis followed, in the fourth of which a cholecystectomy was performed by another surgeon, three years ago. Since then she has been free from symptoms.

CHRONIC PANCREATITIS

DR JOHN E JENNINGS presented a man, thirty-eight years of age, who seventeen months ago was suddenly seized with a severe attack of pain in mid-epigastrium which radiated to the back at the level of the lower ribs. This lasted only a few hours. One year later a similar attack of longer duration was followed by epigastric soreness and nausea for several days. Since that time he has had repeated attacks of indigestion and occasional slight jaundice. He was first seen at his home November 30. Four days ago he had been again seized with sharp epigastric pain and backache with nausea and vomiting. His epigastric tenderness was marked, with no masses and moderate right-sided rigidity. He was slightly jaundiced. He was removed to the Brooklyn Hospital where on a fluid diet with the administration of fluid by rectum in liberal amount his tenderness subsided and his jaundice disappeared. December 6, one week after admission his icterus index was 17. His coagulation time twelve minutes, his bleeding time seven and one-half minutes, his serum calcium 11.7 milligrams in 100 cubic centimetres. December 7, 1926, an incision was made from the tip of the ensiform downward and outward to a point two inches to the right of the navel. The liver and gall-bladder were firmly adherent to the surface of a scar in the abdominal wall. The stomach and duodenum were intimately adherent to the liver. The pancreas was stony hard throughout its length. The stomach and duodenum were dissected free

from the liver edge, the common duct isolated and opened, found dilated and thickened but without obstruction. The gall-bladder which was markedly thickened but contained no stones was removed with two ligatures on the cystic duct and a separate ligation of the vessels. A T-tube drain was placed in the common duct and a raffia dressed tube to the kidney fossa and the abdomen closed in layers. His convalescence was uneventful and he left the hospital sixteen days after his operation, wearing his common-duct drain and a flask attached to it. Six weeks later after a slight indiscretion in diet he came to the office complaining of (1) A central umbilical pain which felt "like a gall-stone pain after a hypo" This pain was almost constant and was reflected to the back, (2) a pain which occurred in paroxysms in front of the left nipple and shot through behind the left shoulder, (3) griping pains low in the abdomen, (4) more or less constant nausea, (5) indigestion and heartburn. A day or two of rest on liquid diet and further caution as to his diet in future was followed by disappearance of these symptoms. The tube was allowed to remain in place for 100 days when it was removed and the drainage closed in a few days and the tract closed. He has had a few slight and diminishing attacks of indigestion and epigastric pain since, but is well if he is careful.

NOTE—Four years ago after several prolonged attacks of indigestion with remittent epigastric and right hypochondriac pain he was operated on for gall-stones, several of which were removed and he thinks his gall-bladder. He has a right upper abdominal scar extending downward from the tenth costal cartilage for four inches.

DOCTOR JENNINGS presented also as a case of chronic pancreatitis, a woman forty-six years of age, who was admitted to the Brooklyn Hospital September 23, 1927 complaining of pain in the right dorsal region radiating to the epigastrium. This pain began two weeks ago quite suddenly. She took warm water and epsom salts. Vomited and was somewhat relieved. Three days later she had a similar attack which was somewhat more prolonged. Two days before admission the present attack began and has been growing more and more severe. She gave a history of an attack of influenza in 1918 and of an operation for colloid goitre intrathoracic, six months ago. She was a large, stout, ruddy woman. Examination of her abdomen which is obese, showed epigastric tenderness, marked on deep pressure with tenderness also present in the right subcostal area. Slight jaundice present. September 27, 1927 an S-curved incision from the tip of the ensiform downward and outward to a point opposite the navel was made. The transversalis was split transversely. The gall-bladder was thick, light in color, adherent to the liver and omentum. It contained many stones. The cystic duct was dilated. The common duct was dilated. The head of the pancreas was hard. The liver was markedly congested, its edge thick and round. The common duct was opened and a stricture found at the ampulla with a small diverticulum containing a stone buried in the head of the pancreas. The stone was removed and the stenosis dilated to 24F with a male sound. The gall-bladder was removed. The vessels and duct were tied separately and a T-tube placed in the common duct. She had a normal convalescence and was discharged October 23. She wore her drain for 100 days with no subsequent inconvenience when it was removed and the sinus promptly closed. She reports herself entirely free from symptoms.

SURGERY OF THE PANCREAS AT ROOSEVELT HOSPITAL BETWEEN 1918-1928

DR ALFRED STILLMAN read a paper with the above title, for which see page 58

DR ALLEN O WHIPPLE said that the making of punctures into the pancreas and incisions through the capsule in cases of acute pancreatitis were associated with definite dangers and difficulties. He had seen one patient operated upon by another surgeon, die on the table as the result of making an incision into the pancreas, and had seen two autopsies in which there was extensive hæmorrhage resulting from it. He can see the reason for making incisions into the pancreas and perhaps they are indicated in very severe types, but thinks it is a great mistake to apply such measures to the pancreatic cases where the entire organ is not involved. The plunging of instruments into the organ means destruction of more pancreatic tissue and further necrosis of the pancreas. For the reasons mentioned in five cases of acute pancreatitis he has operated upon he has not used this method and his mortality has been twenty per cent.

He felt if incisions or punctures are to be done they should be done with extreme caution and only in cases where there is a very marked swelling and hæmorrhage into the pancreas.

DR MORRIS K SMITH said that in going over records of jaundiced patients at St Luke's Hospital he had found a woman recorded as having carcinoma of the pancreas on whom a cholecystogastrostomy had been done and who was alive and well four years later. This was undoubtedly a case of pancreatitis in the light of end result. It furnishes an argument for anastomosis between gall-bladder and gastro-intestinal tract in suitable cases of supposed pancreatic carcinoma.

Doctor Smith had himself operated on an emaciated jaundiced elderly man in whom an enlarged hard pancreas led to the diagnosis of carcinoma. Cholecystogastrostomy was done. Two months later the patient reentered the hospital on the medical service with blood sugar of over 300 and glycosuria. He was under treatment for several months during which time the hyperglycæmia and glycosuria cleared up and he was able to take a regular diet. His jaundice, which was never marked, recurred, due probably to contracture of the stoma. His general condition remained about the same. The course of the disease in this patient over a period of six months' observation, during which time there was development of diabetic manifestations with recovery, raises the question as to the possibility of an inflammatory rather than neoplastic lesion in the pancreas.

DR HOWARD LILIENTHAL said there is one method for diagnosing cancer of the pancreas which is not always thought of and that is the discovery of Vuchow's gland in the neck. He has seen three cases illustrating this. He wished also to throw his influence in favor of cholecystogastrostomy in cancer and especially if proven cancer and if it is not proven cancer and patient is dying of acute jaundice with distension of the gall-bladder it is not going to do any harm. If a patient thus treated remains well for four years this is certainly no argument against the operation. He has heard it spoken against by friends of his own whose opinion he would ordinarily respect because these patients rarely survive for a very long time. If they live a few months without jaun-

dice and itching the patient and his family are well satisfied. One of his most grateful patients died four or five months after this operation and his family were most grateful because of the relief afforded.

DR ALEXIS V MOSCHCOWITZ stated that he has found that patients with carcinoma of the bile ducts and pancreas stand operative interference very poorly. His operative mortality in cases of advanced jaundice, due to carcinoma of the head of the pancreas, has been so appalling even after an ordinary exploratory incision and considerably higher after cholecystogastrostomy or similar operations, that he is now inclined to deny operation when confronted with an undoubted case of carcinoma in this region. Merely to alleviate the not very annoying symptom of itching of the skin is not sufficient indication for him to advise this operation.

As to the paper of Doctor Stillman, Doctor Moschcowitz was in full accord with the opinion expressed by the writer that there are various forms of acute pancreatitis. There are some cases that will absolutely get well without anything being done and there are others that will die whether anything is done for them or not. There remains, however, an intermediate group for which something may be attempted. If there is a definite collection of an exudate or blood in front of the pancreas, Doctor Moschcowitz does not mind incising the peritoneum overlying the pancreas, but he never enters the pancreas itself. He usually drains with large packings of rubber dam. He has succeeded in saving some cases. In the occasional case which is operated upon, usually under mistaken diagnosis and in which small patches of fat necrosis are found throughout the peritoneal cavity without any large exudate in the region of the pancreas and without gall-stones in the gall-bladder, he has usually closed them up without any operative interference upon the gall-bladder. His experience with these cases has been that they do just as well as the cases in which the gall-bladder is drained routinely. It is possible that these patients get well in spite of the cholecystostomy, not because of it.

In this connection, Doctor Moschcowitz related a case operated upon several years ago with a large collection of blood in front of the pancreas. At this time a cholecystostomy was done. The drain was kept up for a very long period, and the patient was about to be discharged with orders to continue the drainage for some time, when suddenly, the patient again became exceedingly ill and had practically the same symptoms as she had at the first operation. A second laparotomy was done and a perfectly fresh hæmorrhage was found in front of the pancreas in spite of the well-functionating cholecystostomy.

DR THOMAS H RUSSELL said that cyanosis is a diagnostic sign that he has paid a good deal of attention to in cases of pancreatitis. In every case of pancreatitis that he has seen cyanosis has been present. He has also noticed that pain in the back when associated with a history of gall-bladder disease was very indicative of chronic pancreatic disease. In operating upon cases of acute pancreatitis he thought it wise to make punctures in the pancreas—these are usually done with the finger—then packing in iodoform gauze to control the bleeding, which he had never found difficulty in checking. In one case of acute

pancreatitis he had made several punctures in the head of the pancreas and the patient later developed a large abscess in the tail of the pancreas which made him think that he had not made enough punctures in the pancreas. In operating upon cases of chronic pancreatitis he has made a practice of suturing a small rubber tube in the common duct having the end of the tube to extend into the duodenum and closing the common duct over the tube. The tube remains in position for three months to a year or more and seems to give better results than the simple T-tube as ordinarily used.

DR FRANK S. MATHEWS wondered whether the relation of gall-stones to pancreatitis is a simple mechanical one. In one of the cases reported by Doctor Jennings there was a single stone in the gall-bladder and no history of stone passing before the attack of pancreatitis. In one of his own cases he had removed a gall-bladder with stones from a patient who developed a subacute pancreatitis two years later from which she recovered without operation. There was no reason to think in this case of the passage of stone at the time of the pancreatitis. Doctor Stillman had referred to a case of dermoid cyst of the pancreas. In any abdominal viscus, except the ovary, they are exceedingly rare. Bland Sutton said, many years ago, that they never occur in any abdominal viscus except the ovary. This is but another illustration in proof that the word "never" should rarely be used in medicine.

DOCTOR STILLMAN, in closing, spoke of Doctor Russell's warning to look for cyanosis as a symptom of acute pancreatitis, he said that although he knew it was regularly described he had never seen it in pancreatitis. In France, during the war, he had a soldier under his care who had all the typical signs of acute pancreatitis with cyanosis of face and extremities. He got so excited over this typical picture that he asked every doctor he could at the post to see the patient. At autopsy it turned out to be a ruptured ulcer of the sigmoid with generalized peritonitis and no pancreatitis. Until Doctor Lilienthal spoke he was going to say one could not tell chronic pancreatitis from carcinoma of the pancreas. Carcinoma, however, is such a short disease that a wait of a month or two will make the diagnosis by a marked loss of weight and strength. As for incising the pancreas, Doctor Stillman felt the incision should be superficial, he did not see the necessity for going deep and perhaps starting a hæmorrhage. He simply opens the overlying peritoneum, if the disease has not already accomplished this. In answer to Doctor Mathews, he had not meant to lay the blame entirely on stones as a cause of pancreatitis although he thought them most important. Drainage of the gall-bladder may not relieve every case because every case is not secondary to the gall-bladder, but where stone is a factor and there is backflow into the pancreas, drainage of the gall-bladder or common duct will probably be helpful.

BRIEF COMMUNICATIONS

SARCOMA OF THE BREAST WITH FOREIGN-BODY AND TUMOR GIANT CELLS*

SARCOMA of the breast with foreign-body giant cells and early local recurrence rarely occurs. In a series of 7763 breasts, or portions of breasts, removed at the Mayo Clinic there were only twenty-nine sarcomas, one of which contained foreign-body giant cells.

REPORT OF A CASE—The patient, a woman, aged fifty-seven years, registered at the Mayo Clinic, February 5, 1929. She had been married twenty-seven years and had never been pregnant. One sister was supposed to have died of cancer of the stomach. The patient was struck by a baseball in May or June, 1928, and she first noticed a lump in the left breast in August. She did not consult a physician until October, at which time partial simple amputation was done. The tumor proved to be malignant. In January, 1929, a nodule appeared in the scar and one Röntgen-ray treatment was given. The nodule continued to enlarge rapidly.

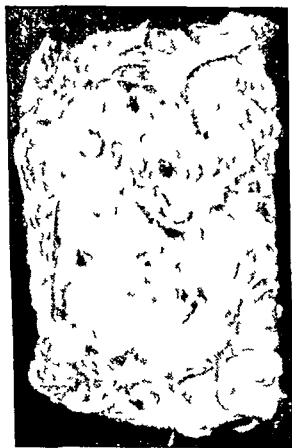


FIG. 1.—Gross section of recurrent nodule.

Examination disclosed three nodules on the left wall of the chest beneath a half circular scar. The patient's general physical condition was good, she had not lost weight. Röntgenograms of the chest, and the Wassermann reaction on the blood were negative. The hemoglobin was 74 per cent.

Radical operation for recurrent malignant growth of the breast was performed February 8. Four tumors were found, the largest of which was 2.5 centimetres in diameter and was situated six centimetres posterolateral from the scar. The tumor next in size was two centimetres in diameter and was situated just beneath the skin in the suture line. Both tumors were cystic, the larger containing a cyst one centimetre in diameter. These tumors were surrounded by dense fibrous tissue. The two smaller tumors were firm and elastic and were situated higher on the wall of the chest nearer the axilla. Neither contained cysts and they were not encapsulated. The smallest measured 1.25 centimetres in diameter and was embedded in fat. The primary tumor (removed elsewhere) measured approximately three centimetres in diameter, was cystic, and surrounded by dense fibrous tissue. All of the tumors were gray. The absence of enlargement of axillary lymph nodes was striking.

The primary tumor consisted of ovoidal and spindle-shaped cells of varying size and lying in a somewhat hyaline matrix. The cytoplasm of these cells stained pink with eosin and the nuclei varied in shape and staining reaction. There were many capillaries throughout the tissue and also hemorrhagic cystic degenerating areas which contained many foreign-body giant cells. These giant cells were round, ovoidal and irregular in shape and contained as many as seventy-five nuclei which resembled endothelial cells, lying in a smooth pink cytoplasm. Through the tissue were many mitotic figures and also tumor giant cells and foreign-body giant cells. The recurrent nodules which were removed showed the same picture as the primary tumor (Figs. 1, 2 and 3). In all the tumors there were a few scattered or collected fat cells.

* Submitted for publication May 3, 1929.

SARCOMA OF THE BREAST

Mammary sarcomas are commonly described as adenosarcoma, adenocystic sarcoma, and so forth, some of which contain foreign-body giant cells. The occurrence of the epithelial glandular element in their structure is most easily accounted for by assuming that they develop in tumors of glandular architecture many of whose elements persist in spite of the sarcomatous change of the connective tissue. Any variety of sarcoma may appear in benign tumors.² If the cells are small and fairly solid, the sarcoma is usually described as round-cell or spindle-cell and if giant cells are present, as giant-cell sarcoma.⁴ Although the presence of the glandular element is sometimes noted, its significance is often neglected in naming the tumor. There are tumors described as having the characteristics of sarcoma and carcinoma.³ If the tumor is large and if cysts have formed in it, all else is likely to be lost sight of and the sarcoma is called cystosarcoma, cystic sarcoma, cystadenosarcoma, or adenocystic sarcoma, if cartilage or bone is found the tumor is called chondrosarcoma, osteosarcoma, ossifying sarcoma or osteochondrosarcoma. Usually by examination of the tumor after removal, and frequently by microscopic study of various portions, the correct pathologic diagnosis can be made.^{5, 6}

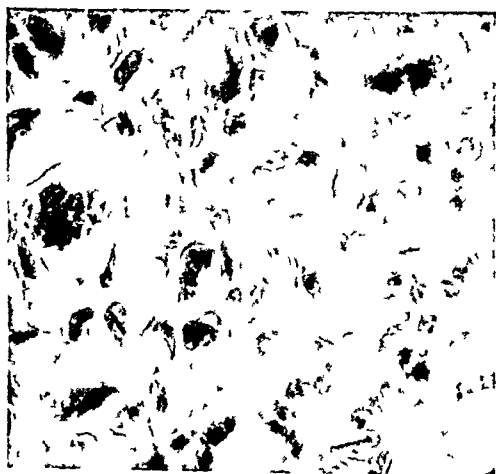
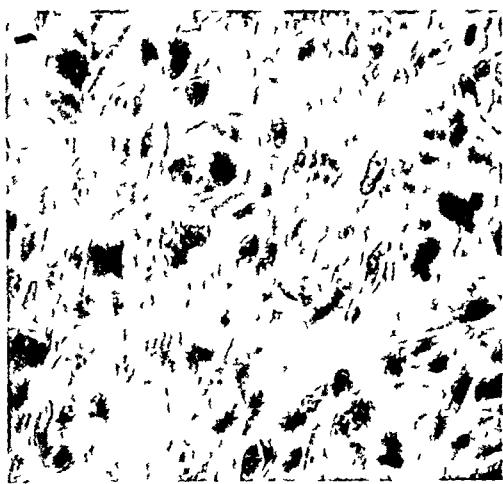


FIG 3—See Fig 2



FIGS 2 and 3—Foreign body giant cells, tumor giant cells, and mitotic figures (X320)

The giant cells seen in the tumors in the case reported here were of two kinds, the foreign-body giant cells and the true tumor giant cells, with the former greatly in excess. The foreign-body giant cells were similar to those seen in giant-cell tumors of bone, tuberculosis, gumma, surrounding a foreign substance such as linen or catgut, blood pigment or cholesterol crystals.¹ Mallory believes that the foreign-body giant cells are formed by fusion of endothelial leucocytes. Maximow, however, believes that they come from wandering or free histiocytes. The true tumor giant cell differs from the foreign-body giant cell by having large irregular nuclei and frequently a mitotic figure.

SUMMARY

This is the first case of sarcoma with foreign-body and tumor giant cells occurring in a series of 7763 breasts, or portions of breasts, removed at the

Mayo Clinic The recurrent nodules were noticed about four months after the primary tumor was removed Primary tumor and secondary nodules all contained foreign body and tumor giant cells

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AN IMPROVED DRAINAGE TUBE

DRAINAGE tubes usually used in the surgical clinics are either too soft and collapsible, *viz*, the Penrose tube the cigarette drain consisting of a strip of gauze drawn through a Penrose tube which, after a few hours, loses its capillarity, because the gauze becomes saturated with the fluid drainage material, the cigarette drain collapses and drainage ceases, or rigid drainage tubes which cause pressure necrosis or hæmorrhage when near a blood vessel It occurred to me that if we could combine the above types without the disadvantages mentioned, we would have an ideal drainage tube

With this premise in mind, last year, in my division, on the service of Dr Joseph Tenopyr, at the Kings County Hospital, I devised the following tube (Fig 1) which proved satisfactory in draining empyema, suppurative appendicitis, cholecystectomy, etc In consists as per illustration, of three equal lengths of Penrose tubing, two of which are cut lengthwise Placing one upon the other, on their convex surfaces, they are rolled like a cigarette, rather tightly and with a forceps drawn through the uncut piece This makes a firm tube, yet not rigid, not causing pressure necrosis or hæmorrhage, always patent, does not kink Any diameter Penrose tubing may be used in making this tube to suit the given case We have used one-half inch for nephrectomy,

RETROPERITONEAL HERNIÆ

three-quarter inch for suppurative appendicitis, and cholecystectomy, one inch for empyema, several one-inch tubes for pelvic abscess drained through the cul-de-sac of Douglass. The tubes have been left for ten days or more in some of these cases, and at no time, when removed, have we found the tube collapsed or kinked. Another advantage with this type of drainage tube is, that if it becomes plugged, the inner rolled cut pieces may be removed and fresh rolled pieces reinserted without any inconvenience to the patient. This tube, like all other drainage tubes, is transfixed with a safety pin, to prevent it from falling into the wound.

The designation "No 83," is because it was on ward No 83, at Kings County Hospital, where this new type of drainage tube was first used. "New," because after a rather careful search of the literature, I have been unable to find it described. As a matter of fact, through my request, the research bureau of Nelson Loose-leaf Surgery referred this question to its editor-in-chief, Dr Allen O Whipple. His answer, quoting his own words, "So far as I know this has not been described in the literature."

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of Brooklyn, N Y

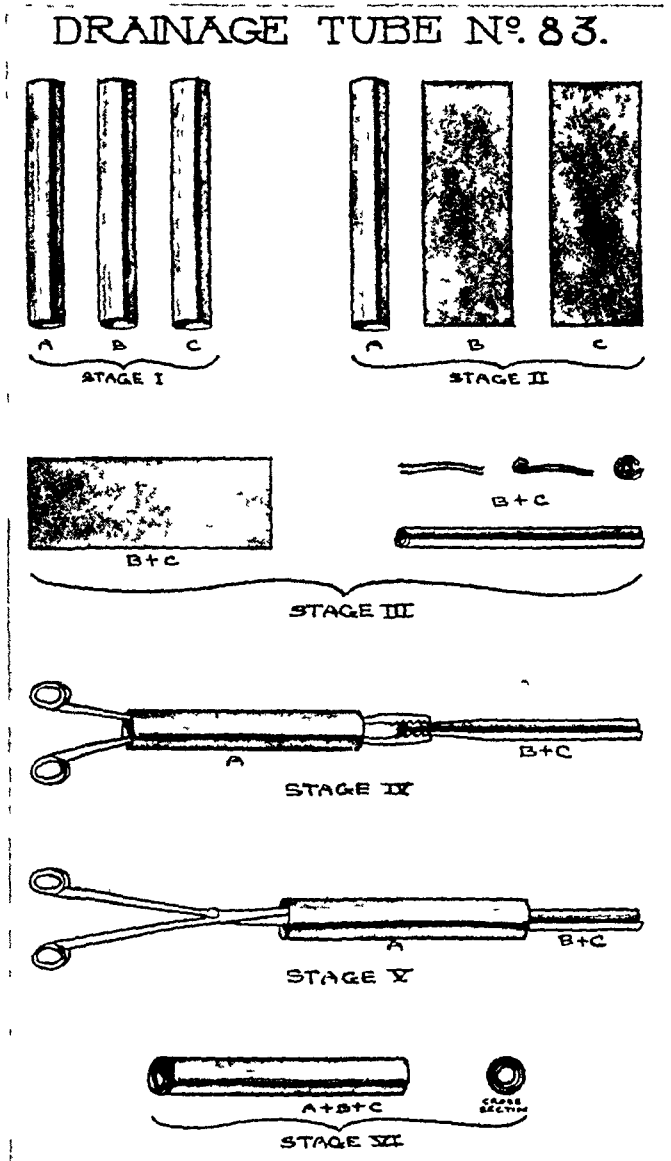


FIG. 1—Stage I Three equal size Penrose tubings (A B C). Stage II Two tubings (B C) are cut open. Stage III Cut tubings are placed one upon the other (B + C), convex sides up, and tightly rolled together upon these sides to have a successful result. Stage IV A long forceps is placed through uncut tubing (A) and then ends of forceps hold rolled tubings (B + C) tightly in place. Stage V Uncut tubing (A) is drawn over rolled tubings (B C). Stage VI (B + C) released, disengage in (A) and form one.

RETROPERITONEAL HERNIÆ

CASE I—Coil of ileum incarcerated in posterior peritoneal pouch—A man, fifty-one years of age, was admitted to Brooklyn Hospital February 23, 1928, on account of abdominal pain and vomiting. One week before admission, he began to suffer from cramp-like pains in lower abdomen, temporary relief was experienced by a cathartic. For two days preceding admission, the previous pains and constipation had returned. Physical

examination was negative except for moderate tenderness in the abdomen. A gastrointestinal series of X-ray pictures was taken and interpreted by the radiologist as indicating obstruction of the small intestine in its proximal half. On the fourth day after admission, condition having persisted, the abdomen was opened under local anaesthesia followed by gas anaesthesia. A large mass of distended ileum was exposed. This was traced to the right iliac fossa where a broad peritoneal band was found, at the edge of

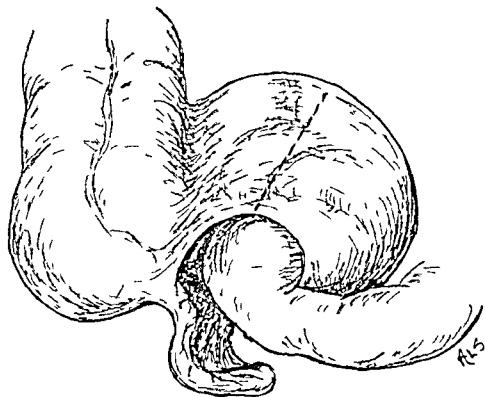


FIG 1—Coil of ileum incarcerated in post peritoneal pouch

which the distended ileum collapsed. This band proved to be the anterior layer of a large peritoneal pouch in which lay about a foot of collapsed ileum (Fig 1). The anterior wall of this pouch was divided freely, laying the space wide open. Following this division, the distended gut gradually contracted and the collapsed gut gradually distended. There was no gross damage to the internal wall at any part. The abdominal wound was closed in the usual manner, uncomplicated recovery followed. The patient was discharged on the eighteenth day after operation. Three months later he was reexamined and reported perfectly well.

retrocolic fossa—A male, twenty-four years of age, was admitted to the Brooklyn Hospital July 18, 1929, with the history that for three days he had been suffering from pain referred to the right lower abdominal quadrant. This was accompanied with nausea. On admission, there was marked rigidity and tenderness over the right lower rectus muscle. Temperature 99, pulse 60, respirations 20, white-blood cells 7800, polymorphonuclears 74 per cent. The abdomen was promptly opened by incision through the lower right rectus muscle which exposed the right iliac fossa, but no appendix appeared. Strong traction on the cecum upward and to the left revealed the appendix folded and fixed in the external retrocolic fossa (Fig 2).

The appendix was removed. It was ten centimetres long and one centimetre in diameter. Its serosa was roughened and the subserous veins were congested. The wall of the appendix was thickened. Sections of the appendix showed marked venous distention and oedema in the tissue spaces, no inflammatory exudate present. Patient made uninterrupted recovery and was discharged on the fourteenth day.

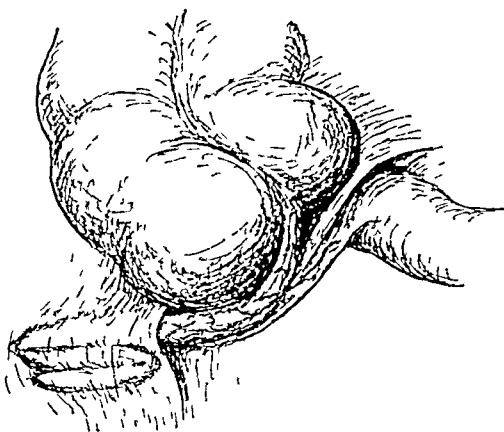


FIG 2—Appendix folded in retrocolic fossa

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BOOK REVIEWS

A SURGICAL DIAGNOSIS, by J LEWI DONHAUSER, M D Large octavo, cloth, pp 799 New York, D Appleton & Co , 1929

It is but a few months (see ANNALS OF SURGERY March, 1929) since the book of the London surgeon, Walton, on "Surgical Diagnosis" was the subject of review in the ANNALS OF SURGERY Here comes a new book from an American clinic, the author of which has been a teacher of surgical diagnosis to students for some twenty years The book is announced as essentially one for medical students, hospital residents and general practitioners As one turns its pages, the impression is strong that it is the outgrowth of methods of class instruction which the author has developed during his many years in the class room This is especially emphasized in the frequency with which charts are employed to present the differential diagnosis of various conditions The author states, in his preface, that illustrations have purposely been omitted except in the chapter on Fractures and Dislocations Notwithstanding this, the book assumes proportions that are notable both for the number and size of the pages

The value of illustrations in a treatise on diagnosis is so great and their use is so imperative, that their absence must necessarily greatly detract from the value of any treatise devoted to the subject of surgical diagnosis and yet, their use in any adequate number must necessarily so swell the size of any book as to take it out of the category of a handbook at once, destroy its usefulness as a class-room textbook for students and relegate the book to the domain of books for reference This is well illustrated in the "Surgical Diagnosis and Treatment," edited by the late Albert J Ochsner, by its four large volumes The book on "Surgical Diagnosis" which perhaps is most nearly comparable to this one of Donhauser is that of De Quervain (1926), which is about the same length (pages 937) but contains 750 illustrations If one chooses for purposes of comparison such a subject as Tumors of the Side of the Neck, one cannot help but realize the extreme importance and value of such a series of illustrations as the book of the Berne surgeon presents as placed by the side of the meagreness and insufficiency of the information on the subject which the pages of the Albany surgeon, devoid of illustrations, give to their readers And so, one might go on through many other subjects On the other hand, the book of Donhauser has its own merits Special importance and value are attributed to proper history taking and a considerable amount of space is devoted to proper methods of procedure The regional and etiological charts which have already been mentioned, are a special feature of the book These however are redolent of the class room and really need the presence and exposition of the teacher for their proper use

BOOK REVIEWS

This book of the Albany surgeon is especially timely as a contribution to the general discussion of the place in medical education which a small hospital medical school may fill. That such a place has been in the past a not insignificant one, the careers of such men as Corydon Ford, Moses Gunn, James R. Wood, Hugh H. Toland and many others demonstrate.

DIABETIC SURGERY By LEI AND S. MCKITTRICK, M.D., and HOWARD F. ROOT, M.D. Octavo, cloth, pp. 269. Philadelphia, Lea & Febiger, 1928.

The surgery of diabetes, long a matter of despair and failure, has been placed upon a new footing by the introduction of insulin in the treatment of diabetes and the present book is planned by its authors to describe the new surgery which has sprung out of the "Banting Era." In this book the authors present the results which have been obtained at the New England Deaconess Hospital during recent years. As the authors state in their preface, they have attempted to paint a composite picture of the conditions found in a large series of cases and to describe the methods of medical and surgical treatment used. The results which are summarized in the book itself present an entirely new and most encouraging statistic for the new surgery. As Dr. Daniel F. Jones remarks in his foreword: "Up to the introduction of insulin, nearly all surgery in diabetic patients was peremptory surgery, but thanks to insulin and the recognition of the value of cooperation between physicians and surgeons, diabetic patients may now be treated as any other group. In fact, diabetic patients who may require operation at any time, should be urged to be operated upon when they can be under the care of a physician and surgeon who have had experience in this group of cases and who have worked together."

This book quite fully and satisfactorily answers the indications which the authors have set for their work. It occupies a field which thus far has been unoccupied. Although it is true that the possibilities of surgery in diabetes have often engaged surgical attention, the record of past contributions to surgical literature in diabetes has been one of despair and defeat. Now, however, since an adequate control of the diabetic condition is within the reach of surgery, despair and defeat have been turned into accomplishment and victory. We hail, therefore, with unusual pleasure the appearance of such a book as is now before us as a herald of the better surgery of the future.

EDITORIAL ADDRESS

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No 2

EVALUATION OF BLOOD CLOTTING FACTORS IN SURGICAL DISEASES

WITH SPECIAL REFERENCE TO THROMBOSIS AND EMBOLISM AND CERTAIN BLEEDING CONDITIONS

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AND

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FROM THE DEPARTMENTS OF SURGERY AND PEDIATRICS OF THE FIFTH AVENUE HOSPITAL

THE surgical calamities of phlebitis and of embolism face every surgeon in almost any operation he may perform. They arise often without noticeable warning, and the results are heartbreaking. To have a patient, following an interval appendicitis operation, suddenly die on the eve of leaving the hospital is a most disturbing calamity. Thrombosis and embolism have been subjects of study by many clinics. We may assume, probably without danger of contradiction, that the following etiological factors are considered to be the most important

(1) Trauma, (2) infection, (3) slowing of the blood stream, and (4) increased viscosity of the blood

We believe that these factors are necessary to create thrombosis and phlebitis, but many patients probably have all of these factors present and yet do not develop phlebitis or thrombosis, while other patients with a minimum number of the factors readily succumb. Assuming therefore, that there must be a variant in the constituents of the blood of patients which may predispose toward thrombosis, we decided to make a routine quantitative study of the factors involved in blood clotting in the case of all patients admitted into the surgical service of the Fifth Avenue Hospital.

It has been demonstrated clinically that the bleeding and clotting time is not always a true indication of the degree of the patient's blood coagulability, hence quantitative determination of each individual factor of clotting has been studied. We felt that if every case were examined before operation, and then three and five days post-operative examinations were made, we might be able to determine the normal and abnormal reactions to surgical procedures. In all, two hundred cases have been thus examined. We knew that food and certain drugs affected the blood-clotting constituents, and, therefore, we felt that if we could predict a predisposition to either clot or bleed we might be able to correct the defect. Through the generosity of Mr Charles Frueauff we have been able to employ a full-time technician to study this problem. We feel that our results thus far are significant, and justify this preliminary report. The scope of the work has carried us over a larger field than we had anticipated, because, with the study of clotting we soon found that certain types of bleeding came under our study. We wish, therefore, to report

briefly on certain cases of bleeding that will later be the basis of special reports. Our present report includes

(1) Cases of thrombosis and embolism, (2) bleeders, studied in reference to tonsillectomy, (3) new-borns with hæmorrhagic disease, (4) the dietary treatment of bleeding and clotting conditions

On initiating these investigations the following tests were made on every case, save emergencies, admitted to the hospital

(1) The bleeding and clotting time, (2) the prothrombin index, (3) the antithrombin index, (4) the fibrinogen content, (5) platelet count, (6) the degree of platelet disintegration, (7) analysis, from the above tests, of the blood-clotting function index

Recently we have omitted the bleeding and clotting time, as we obtained very little information therefrom. At first, tests were taken before breakfast, or with the omission of breakfast but of late we have found that blood taken two or three hours after breakfast shows no variation, so that the procedure is simplified thereby

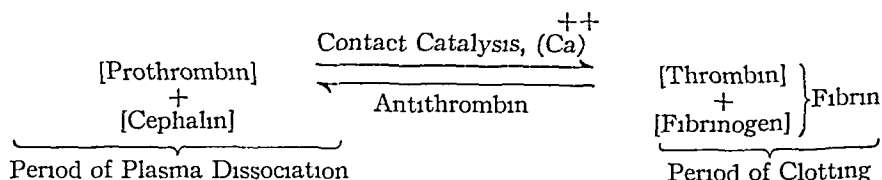
In order to amplify the theories on which we have based our work we mention briefly the accepted mechanism of blood coagulation and the accepted theory for thrombosis. In addition we include in detail the methods of determining the various blood-clotting substances

Determination of the Blood-Clotting Function—Hæmorrhagic diatheses constitute a group of disorders resulting from a deficient blood-clotting mechanism. The variety of hæmorrhagic affections has not been satisfactorily classified because of the complexity of the clotting process. Recent advances in chemistry,¹ however, have made it possible to determine the character of the substances involved in the coagulation of blood. This knowledge provides a more substantial basis for the early recognition, prevention and treatment of hæmorrhagic diseases

Physicochemical studies reveal that blood plasma, so long as its constituents are not dissociated by extraneous forces, is a single complex in equilibrium, rather than a mixture of substances. The initial views of Harvey (1653) and of Woodhidge (1886) have come into their own again—"blood plasma is protoplasm and clotting is the last act of living blood"

Blood when shed exhibits the striking physiological function of dissociating into the components necessary for the clotting reaction. The blood-clotting function then depends first on the degree of dissociation of plasma—the incubation period of clotting—and second, on the liberation of certain substances in sufficient concentration to form a gel—the actual clotting. The dissociation of shed blood adequate to yield a clot is a determining pre-clot function

A graphic presentation of this process would be as follows



BLOOD-CLOTTING MECHANISM

When blood is shed the plasma dissociates into substances which yield a clot. During the patent period of dissociation antithrombin is precipitated and prothrombin is activated by calcium ions. The resulting thrombin gels soluble fibrinogen into insoluble fibrin.

FACTORS PRODUCING CLOTTING IN THE BLOOD STREAM

Having reviewed the accepted mechanism of normal clotting we must now consider what happens in abnormal conditions, and why, in diseases and trauma, we find spontaneous clotting in the blood-stream. The three factors which are most commonly recognized as producing spontaneous blood clotting are (1) changes in the character of the blood, (2) changes in the rate of the blood flow and (3) changes in the vessel walls.

It has long been recognized that a clot can be started by throwing out to the periphery the blood platelets when the circulation is slowed down. As these blood platelets clump along the portion of the vessel wall there takes place a coagulation of the blood, forming a red clot around this nucleus of platelets. The great question which comes up is whether this formation of clot can take place with only a slowing of the circulation or trauma, or whether there must be first a change in the blood-clotting elements of the blood. Some² writers feel that mild damage to the liver stimulated fibrinogen formation. Others¹ think it is an interaction of the liver and the adrenals. One of the most interesting pieces of work has been done by C. A. Mills¹ in connection with the effect of diet on clotting and basal metabolism. In this work he shows that a carbohydrate and fat diet will raise the basal metabolism, but will not increase clotting, while a protein diet not only raises the basal metabolism, but definitely increases the blood-clotting elements. He attributes this to some unknown factor connected possibly with the amino acids derived from protein metabolism. The quantitative determination of the dissociated compounds involved in blood coagulation is a measure of the clotting function of blood. Such a study indicates the nature of the clotting deficiency and hence the hæmorrhagic status of a patient. The total number of determinations may be carried out in an hour.

Our approach to the solution of bleeding problems has been to quantitate the clotting components as a basis for the classification of hæmorrhagic diatheses as well as for the administration of rational therapy.

Clotting Time (General Statement) —The blood-clotting time is essential, but not conclusive for determining the hæmorrhagic tendency of a patient. The clotting time may be normal though spontaneous bleeding be present, *i.e.*, in purpura and jaundice, and clotting may be delayed although there be no hæmorrhage.

The determination of the clotting time of blood passing through skin is no criterion of the true clotting status of blood and hence no indication of

what might be expected in the operative field of other tissue. All injured tissues, as well as blood when shed, dissociate into substances conducive to their coagulation. This contributory tissue factor may be eliminated by taking the clotting time by vein puncture.

Clotting Time (Vein Puncture)—Draw one cubic centimetre of blood and transfer to a test tube eight millimetres in diameter (the greater the diameter of the tube, the slower the clotting). Place the tube in a water bath at 38°C *. Coagulation is complete when the tube can be inverted without displacing the clot. (Normal, five to eight minutes.)

Clotting Time (Skin Puncture)—Touch the end of a capillary tube (3 cm \times 0.6 mm) to the first drop of blood issuing from a stab in the finger or ear. Place in the creases of the palm and cover by closing the hand to maintain a fairly uniform temperature (34° – 35°C). The clot *initiation time* (latent period) is the first visible departure from fluidity. The clot *formation time* is the first fibrin thread seen between the ends when the capillary is broken by bits every half minute. (Normal, three to five minutes.)

Antithrombin (Definition and Characteristics)—Antithrombin is the substance maintaining the stability of the plasma complex. When blood is shed the dissociation of the plasma produces clotting components which, by mass action, decrease the stabilizing effect of the antithrombin. Its content is directly proportional to the colloid stability of the blood. High antithrombin values indicate a hæmorrhagic tendency and low values indicate accentuated coagulability of blood.

Antithrombin Index †—Blood obtained by skin puncture is drawn into a Wright tube, allowed to clot and then centrifuged, 0.1 cubic centimetre serum is drawn off into a small test-tube by means of a capillary pipette and heated in a water bath at 60°C for ten minutes. (Prothrombin is thus destroyed.) A control blood is carried through the same procedure. The heated serums are cooled and to each is added 0.3 cubic centimetre prepared thrombin solution. The tubes are placed in a water bath at 38°C for fifteen minutes. An 0.5 cubic centimetre prepared fibrinogen solution is finally added to each tube and the clotting time is observed at 38°C . The antithrombin index is the ratio of the clotting time of the patient's blood to that of the control.

TABLE I
Antithrombin Test

Heated serum cc	Thrombin cc	Fibrinogen cc	Clotting time at 38°C	
0.1	0.3	0.5	Control	Patient
			5 minutes	x

Incubation time, 15 minutes

Preparation of Fibrinogen—Blood from the slaughterhouse is drawn into a vessel containing sufficient sodium citrate to give a final concentration of 0.5 per cent. The plasma is collected by centrifugation and to each twenty-five cubic centimetres are added four grams of sodium chloride. The precipitate fibrinogen is collected, washed several times in 15 per cent sodium chloride containing 0.5 per cent sodium citrate and finally dissolved in twenty-five cubic centimetres of 0.5 per cent sodium citrate.

Preparation of Thrombin—Twenty-five cubic centimetres of the plasma, collected

* A suitable thermostat consists of an unsilvered Dewar tube containing water at 38°C and covered with a cork with holes for small test tube.

EVALUATION OF BLOOD CLOTTING FACTORS IN SURGICAL DISEASES

by the above procedure, is precipitated by ten grams of ammonium sulphate and filtered by means of a Buchner suction funnel. The ammonium sulphate is expressed as completely as possible to obviate the necessity for dialysis. The precipitate containing the plasma prothrombin may be preserved for weeks as a moist paste. The thrombin solution is prepared by dissolving 0.25 grams of the paste in ten cubic centimetres of water, adding two cubic centimetres of an 0.1 per cent emulsion of cephalin and 2 cubic centimetres of a one per cent solution of $\text{CaCl}\cdot 6\text{H}_2\text{O}$. This thrombin solution remains active for several hours.

Prothrombin—Prothrombin is a protein substance identified with albumin and globulin and is electro-negative in blood. It acts as a nucleus of electrical condensation of the clotting components in the formation of a gel. Its concentration is directly proportional to the clotting activity of blood. High values indicate accentuated coagulation of blood and low values indicate a tendency to bleeding.

Prothrombin Index—Blood obtained by skin puncture is drawn into a Wright tube containing 0.1 cubic centimetres of 1 per cent sodium oxalate and centrifuged. One-tenth cubic centimetre of the plasma is placed in three tubes (6.8 x 1.3 cm, flat bottom) in a water bath at 38° C and to these are added in series 0.1, 0.2, 0.3 cubic centimetre of 0.5 per cent $\text{CaCl}\cdot 6\text{H}_2\text{O}$. The shortest clotting time in the series is the prothrombin time. The prothrombin index is the ratio of the clotting of the control to that of the patient's blood.

TABLE II
Prothrombin Test

Oxalated plasma	0.5 per cent CaCl	Clotting time at 38° C	
		Control 3 minutes	Patient x
cc	cc		
0.1	0.1		
0.1	0.2		
0.1	0.3		

Fibrinogen—Fibrinogen constitutes the potential clot structure dispersed in the plasma in the most readily precipitable form. Its transformation into soluble fibrin completes the clotting reaction. High fibrinogen content accelerates clotting and synæresis or retraction of the firm fibrin clot from the gel. Low fibrinogen content gives a non-resistant skein inadequate for retraction in arresting hæmorrhage.

Fibrinogen Value—Blood is drawn into a tube containing 0.2 cubic centimetres of 3.5 per cent sodium citrate and centrifuged under alcoholene. The refractive index of one drop of the plasma at 38° is estimated by means of a Pulfrich Refractometer. One-tenth cubic centimetre of 1.5 per cent $\text{CaCl}\cdot 6\text{H}_2\text{O}$ is added to the tube to coagulate the fibrinogen, and is then centrifuged. The refractive index of a drop of the serum is then determined. The percentage of the blood fibrinogen is the difference between the indices of plasma and serum multiplied by the factor 0.187.

DETERMINATION OF PLATELETS

Platelets are lipoidal protoplasmic separations from megakaryocytes in the bone-marrow. Clotting of blood takes place, other factors being equal when there is an adequate platelet content and a rapid platelet disintegration, liberating phosphatides. In fact platelets which do not agglutinate rapidly are functionless for clotting.

Platelet Count—Draw blood with a red blood count pipette and dilute with 3 per cent citrate (1:200) without adding any stain as a diluting agent. Allow the cell to stand for ten minutes before counting the platelets in the customary counting chamber.

*Platelet Lysis Percentage*⁸—Blood is collected into a short paraffined tube and platelet counts are made at fifteen-minute intervals, counting only those which are single and not agglutinated into clumps. The platelet lysis percentage is the fraction of the platelets which disintegrates within one hour.

Calculation of the Index of Blood-Clotting Function—Normal blood shows on analysis that the clotting components are contained in fairly constant concentrations. Typical normal values are given as representative of determinations made on patients with normal blood-clotting function.

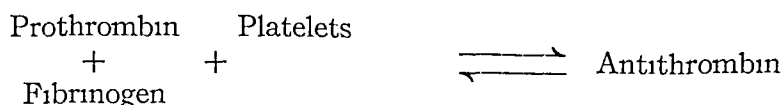
TABLE III
Blood Analysis of Clotting Components (Normal Values)

Name	Diagnosis	Clotting time	Bleeding time	Prothrombin	Fibrinogen	Antithrombin	Platelets	Platelet disintegration	Clotting index
					Per cent			Per cent	
	Post-auricular abscess	5'15"	1'30"	1 0	0 56	1 04	240,000	40	0 5
	Chronic appendicitis	3'30"	2'30"	1 0	0 54	1 0	300,000	50	0 5
	Cysto-pyelitis	4'30"	1'30"	1 0	0 54	1 0	350,000	71	0 5
	Perineal repair	4'15"	2'0"	1 0	0 60	1 0	225,000	59	0 6
	Recto-vaginal fistula	5'0"	2'0"	1 0	0 64	1 04	185,000	45	0 6

The constancy of the values in blood-clotting functions is evident from the above data on some of the patients studied as controls. The variation in platelets is within the accepted normal range. We have come to believe that high platelet counts are associated with chronic infections.

The rate of platelet disintegration at the end of one hour is over 40 per cent, the low normal level.

A composite value of the ability of a blood to clot may be calculated from these determinations. Certain of the blood substances, *i.e.*, prothrombin, fibrinogen and platelets, tend to favor clotting, and others (antithrombin) tend to reverse this process, *i.e.*, favor bleeding. In this chemical mechanism the activity for clotting or bleeding is proportional to the concentration of each interactive substance.



Expressing this reaction in terms of the law of mass action, we have

$$\frac{[\text{Prothrombin}][\text{Fibrinogen}][\text{Platelets}]}{[\text{Antithrombin}]} = 1$$

EVALUATION OF BLOOD CLOTTING FACTORS IN SURGICAL DISEASES

Introducing normal values for these substances,

- Prothrombin Index = 1
- Fibrinogen = 0.5 per cent
- Platelets = 200,000
- Platelets Lysis = 50 per cent in 1 hr
- Active Platelets = 100,000
- Antithrombin Index = 1.0

The normal index of clotting function of blood is, therefore, 0.5 ± 0.2 . Values over 1.0 indicate a marked tendency to clot and values below 0.2 indicate a marked tendency to bleed.

TABLE IV
Blood Analysis in Diseases with Altered Clotting Function

Name	Disease	Clotting time	Bleeding time	Prothrombin	Fibrinogen	Antithrombin	Platelets	Platelet Disintegration	Clotting Index
Bleeding Cases	Hemophilia	10'0"		1.00	Per cent 0.64	1.11	95,000	Per cent 15	0.008
	Hæmorrhagic disease new-born	11'15"		0.66	0.19	1.5	165,000	20	0.04
	Hemophilia	5'0"	4'0"	0.66	0.54	1.57	250,000	24	0.2
	Nutritional bleeder	4'30"		0.87	0.46	1.25	240,000	62	0.3
Clotting Cases	Mesenteric thrombosis	2'30"	1'30"	1.54	0.93	0.75	440,000	67	1.9
	Gall-stones Gastric polyp Complication—thrombosis	3'30"		1.54	0.93	0.75	300,000	50	1.9
	Cardiac with embolus in popliteal artery	3'15"	4'30"	1.7	1.12	0.46	275,000	83	4.1

The clotting function index has been a more accurate clinical criterion of the condition of the patient than has hitherto been available by laboratory methods. In certain chronic diseases, however, in which the platelets have been markedly increased, no direct relation has been observed between the unusually high clotting index and the possibly increased blood coagulability. We have therefore evaluated the clotting function from the limiting factors

$$I_a = \frac{[\text{Prothrombin}][\text{Fibrinogen}]}{\text{Antithrombin}}$$

The normal index thus becomes 0.5 ± 0.2

TABLE V

Classification of Diseases in Which Blood-Clotting Function is Altered

				Pro-thrombin	Fibrinogen	Anti-thrombin	Platelets
Blood-clotting function in disease	Increased Index > 0.8	Infection	Thrombosis	+		-	
			Thrombo-angitis obliterans		+		+
			Phlebitis	+		-	
			Pneumonia		+		+
			Tuberculosis				+
		Metabolic	Diabetic gangrene				+
			Cholelithiasis	+	+	-	
			Renal colic		+		
			Carcinoma				+
	Normal Index = 0.5	Physical	Trauma				
			Congestion				
			Hypertension				
			Surgical				
	Decreased Index < 0.2	Hereditary	Melena neonatorum	-			lysis decreased
			Hemophilia				
			Epistaxis				
			Hemoptysis				
		Blood	Secondary anæmia	-	-	+	
			Pernicious anæmia				-
			Chlorosis				-
			Leukemias	+			
		Liver	Stenosis bile-duct				-
			Cirrhosis	-			-
			Jaundice				-
		Infections	Acute infectious			+	-
			Typhoid		-	-	-
			Syphilis		-		-
			Arthritis			+	
		Toxic	Purpura				-
			Benzol allergy	-			-

THROMBOSIS AND EMBOLISM

In carrying on this work it has been our plan to analyze cases and to attempt, by studying the various factors of blood clotting, to see if we could discover one variant, or one single test that would indicate the blood picture.

Our first index was formed from the following factors: Prothrombin index, antithrombin index, fibrinogen content, platelet count, and the degree of platelet disintegration. A study of the platelet count and platelet disintegration rate showed that infection, especially in such cases as tuberculous peritonitis, was too great a variant to be a satisfactory guide for clotting factors, so the platelet count and platelet disintegration rate were eliminated.

The next index used consisted of prothrombin, fibrinogen and antithrombin. With this as a basis, our entire series of cases was again reviewed. The actual thrombosis and embolism cases still remain in this group, but the per-

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TABLE VI

Case	Operation	Disease	Blood index				Type of blood condition	Treatment of second operation	Course
			1	2	3	4			
I J C	Embolectomy	Myocarditis	11 Ind				Myocarditis embolus in femoral artery	Embolectomy amputation of thigh	Amputation—Death thirty-fifth day Myocarditis
			16 A						
II R M	Excision gastric polyp and cholecystectomy	Cholelithiasis	09 Ind	19 Ind			Embolus in brachial artery sixth day post operative	Embolectomy	Death in twenty-four hours
			1 A	7 A					
III F F	Mesenteric thrombosis	Myocarditis	19 Ind	15 Ind	19 Ind		Mesenteric thrombus femoral embolus	1-Enterostomy 2-Resection of intestine 3-Closure of enterostomy	Death forty-eighth day Signs of thrombosis in iliac arteries Myocarditis
			7 A	7 A	7 A				
IV R H	Appendectomy	Chronic appendicitis		16 Ind			Pulmonary embolus ninth day Phlebitis left Intravenous saphenous thirtieth day	Intravenous injection of gentian violet for phlebitis	Gradual recovery Quick subsidence of phlebitis after injection
				8 A					
V C R	Laparotomy Pelvic repair Appendectomy	Retroversion lacerated cervix and perineum	06 Ind	07 Ind	06 Ind	14 Ind	Left phlebitis femoral vein eleventh post operative day	Intravenous injection of gentian	Temperature normal in seven days
			1 A	1 A	1 A	08 A			
VI J B		Thrombosis of brachial vein	10 Ind	10 Ind	05 Ind		Thrombosis	Elevation Diet	Left hospital at end of ten days Slow convalescence
			8 A	8 A	1 A				
VII B		Phlebitis		18 Ind			Saphenous vein	None	Elevation of leg and diet
				8 A					
VIII H F		Thrombosis	7 Ind	2 Ind	2 Ind	13 Ind	Both iliac veins	None	Pellagra on first admission Put on high protein diet
			7 A	7 A	8 A	8 A			
IX S D	Salpingo-tomy Appendectomy	Chronic salpingitis Chronic appendicitis		09 Ind			Phlebitis	Intravenous injection of gentian violet	Slow convalescence
				08 A					
X L		Phlebitis		12 Ind			Phlebitis following pregnancy	Rest in bed	Slow convalescence
				8 A					
XI S L	Cholecystectomy Appendectomy	Cholelithiasis chronic appendicitis	05 Ind				Phlebitis of internal saphenous vein	None	Hæmatoma in wound and infection Phlebitis three days after leaving hospital
			08 A						

centage of high indices (33 per cent) in the post-operative cases not showing definite phlebitis was too high to be of value from a prognostic viewpoint. Therefore, after studying prothrombin and fibrinogen, and finding that they had no real value as an index, we found that antithrombin used as an index included all of our definite thrombosis and embolism cases and gave only 18

per cent of suspects in the unproved cases. If by further study this test can be shown to be a reliable index the procedure can be simplified and so arranged that it can be performed as a routine test by a technician.

The blood of 205 cases has been examined in a routine manner both pre- and post-operatively on the Surgical Service of the Fifth Avenue Hospital. In this series we have studied eleven cases who have had thrombosis, phlebitis or embolism. The abbreviated histories of these cases are tabulated below.

Our clotting index of 0.5 is normal and any increase over 0.7 is suggestive of increased clotting tendencies. With antithrombin as an index 1 is considered normal and any decrease below 0.9 is suggestive of increased clotting. In the table both the results of the blood clotting index (Index) and the antithrombin determinations (A) are given.

CASE I—J. C., a woman sixty-four years of age, was admitted to the Medical Service March 15, 1928. She had had heart trouble for two years, and was admitted with generalized œdema and acute cardiac failure. Six days after admission she complained of sudden pain in the left leg about the knee. She was seen by the surgical department four hours later at which time no pulsation of the femoral artery could be felt beyond Poupart's. Her leg was cold to the knee, and there was an area of discoloration beginning about three inches above the knee and extending down to the toes. No pulsation could be felt nor was there any sign of skin circulation. Above this demarcation area the skin was hypersensitive. A diagnosis of embolus in the popliteal artery was made. She was immediately taken to the operating room and under spinal anæsthesia, an incision was made on the posterior surface of her thigh down to the popliteal space. The artery was opened proximal to the knee-joint, and a clot about four inches long was dislodged from the femoral artery. This was followed by active bleeding, but further clots were felt down below the knee. These were removed. The wound in the artery was sutured. The following day the leg was still cold and blue, and an amputation was done in the upper third. Examination of the artery later showed a very marked obliterating endarteritis with organizing thrombus. The patient lived for thirty-five days following the amputation, and died of a myocarditis.

Comment—A woman who had been treated by the medical side suddenly developed an embolus in her femoral artery. Clotting index, after the development of the embolus, was 4.1 and the antithrombin 46. This patient showed marked clotting powers, and the examination of the amputated leg showed changes in the intima of the artery, with obliterating endarteritis. During the operation for embolism it was noted that the blood clotted very readily in attempting to remove the embolus.

CASE II—R. M., a woman, about fifty-five years of age, was admitted to the Surgical Service April 24, 1928, complaining of severe epigastric pain, distention, and anorexia at all times, aggravated by food. In the upper abdomen there were shooting pains to the right scapula. X-ray showed gall-stones and a deformity of the cap. Operation May 4, 1928. Two polyps were found in the antrum about an inch proximal to the pylorus. These were excised and the wound in the stomach closed. A small contracted gall-bladder containing a stone about two centimetres in diameter was removed and the cystic duct ligated. This patient had a rather high immediately-post-operative temperature for twenty-four hours, when it returned to 99°. On her sixth post-operative day she got out of bed and fell on her left arm. Shortly thereafter she had sudden pain in the left arm, with discoloration and coldness from the mid-portion

of the arm to the fingers. A pulse could be felt just below the pectoral muscle, but could not be traced down the arm beyond this area. Diagnosis of embolism was made, the patient taken to the operating room and an incision about a half inch long made in the brachial artery. A clot five inches long was removed, which was followed by active arterial bleeding. A small ureteral catheter was inserted upward and the lumen washed out so that very marked bleeding followed. The wound was then sutured. No pulse recurred at the wrist and the patient's condition failed gradually and she died the following day with high temperature and signs of myocardial failure.

Comment—Woman operated on for polyp of the stomach and cholelithiasis. Her ante-operative examination showed a clotting index of 0.9 and an antithrombin of 1. The clotting index was high, but the antithrombin was normal. On her fifth post-operative day her clotting index was 1.9 (very high) and her antithrombin 7—both showing evidence of increased clotting tendency. The following night this patient got out of bed, fell on her left arm, and developed either a thrombus in the artery, or an embolus. In this case definite warning was exhibited by the blood examination that the patient had a tendency toward thrombosis.

CASE III—F. F., private patient of Dr. G. W. Roberts, was admitted to the Fifth Avenue Hospital July 25, 1928 with symptoms of abdominal pain and vomiting. At operation eighteen inches of gangrenous intestines with a very oedematous mesentery were found. Healthy intestine was found both proximal and distal to this gangrenous loop. The two healthy loops were sewed together and the gangrenous portion brought outside the abdominal wall. The wound was then closed and the gangrenous intestine covered with vaseline and rubber. Later operations were done for resection of end-to-end anastomosis. The patient died September 11, 1928, with symptoms suggesting an embolus in femoral artery.

Comment—Patient admitted with mesenteric thrombosis, showed on admission clotting index of 1.9 and an antithrombin of 7. On two subsequent examinations the clotting index was 1.5 and 1.9 and the antithrombin 7 and 7. This patient eventually died with symptoms suggestive of *femoral embolism*. During the patient's entire stay in the hospital the clotting index was high and showed a tendency toward clotting.

CASE IV—Mrs. R. H. was operated on June 7, 1928, with a diagnosis of subacute appendicitis. The appendix, which was found to be enlarged, with very dilated blood-vessels and thickened wall, and bound down by very firm adhesions, was removed. On her ninth post-operative day she had a sudden attack of pain in her left chest, cough and bloody sputum. Her X-rays showed cloudiness over the left lower lobe. The symptomatology was very suggestive of pulmonary embolus. Two days after her discharge from the hospital, on her thirtieth post-operative day, she developed an acute femoral phlebitis of the left leg, with a temperature of 103°, with marked swelling and coldness of the leg. Two days later forty cubic centimetres of 5 per cent of gentian violet was injected intravenously. The pain ceased in twenty-four hours. Following this her convalescence was slow, but uneventful.

Comment—On her ninth post-operative day she had symptoms suggesting pulmonary embolus, although the X-ray diagnosis was pleurisy. The day after the symptoms in the chest the clotting index was 1.6 and the antithrombin 8, showing a marked clotting tendency. On the patient's thirtieth

post-operative day she developed an acute femoral phlebitis of the left leg, with a temperature of 103° , swelling and coldness

CASE V—Mrs C R, thirty-six years of age, was admitted to the Fifth Avenue Hospital November 12, 1928. Diagnosis of lacerated cervix and perineum, with retroversion. Operation: Repair of perineum and cervix and shortening of the round ligaments, with appendectomy. She ran a slight elevation of temperature for ten days post-operatively. On her twelfth day she had an elevation of temperature to 101° , and swelling, pain and coldness in the left thigh. The following day she was given an injection of 40 cubic centimetres of 5 per cent gentian violet intravenously. There was a gradual subsidence of her temperature, so that it was normal after her nineteenth post-operative day, and she was discharged on her twenty-ninth day.

Comment—The patient developed a left phlebitis in her femoral vein on her eleventh post-operative day. Her blood examinations, on her third and fifth pre-operative days, were negative for clotting tendencies. Examination after development of the phlebitis showed a clotting index of 14 and an antithrombin of 8. This patient developed a thrombus five days after her third routine examination. It is possible if a subsequent examination had been done two or three days before the development of the phlebitis, changes in the clotting time might have been observed.

CASE VI—Mrs J B, forty-eight years of age, was admitted to the Fifth Avenue Hospital November 25, 1928. Diagnosis on admission was thrombosis of right brachial vein. Patient is a teacher, and was taking in receipts at the door of a school bazaar on the day before illness. During most of the afternoon she had sat in a low chair with the right arm resting on the edge of a table. Patient had been well physically up to this time, but very tired. Woke up early the following morning with a dull ache in right arm and, on getting up, found that arm was swollen, and became purple on hanging it down. At no time did patient have temperature or rise in white count.

Comment—A woman who, with the slightest amount of trauma—merely resting her arm on a desk—developed a thrombosis of the brachial vein. On admission to the hospital her clotting time was 1, antithrombin 8. After being placed on a bleeding diet, six days later her clotting index was 5 and antithrombin 1, which were normal. This patient apparently had the clotting elements decreased in her blood by dietary measures. Further check-up on February 7, 1929, showed index 16 and antithrombin 15. Patient had not added protein to diet as advised, for fear of another accident.

CASE VII—B, thirty-five years of age. Quite an obese woman who had suddenly developed painful swelling over a series of anterior lateral radicals of the internal saphenous vein. On examination there was a red area of skin about five inches long by two inches wide through which could be felt a hardened, indurated vein. There was no history of previous trauma or operation. Patient treated by elevation, rest in bed and diet.

Comment—A woman without previous trauma or operation developed phlebitis. Her blood picture at the height of phlebitis showed a clotting index of 18 and an antithrombin of 8.

CASE VIII—H F, a woman, twenty-seven years of age, was admitted to the Fifth Avenue Hospital October 29, 1928, complaining of symptoms suggesting cholecystitis,

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and also complaining of marked stomatitis, with skin lesions of the dorsum of both hands suggesting pellagra. She was placed on a high protein diet and discharged to the Out-Patient Department. She was readmitted to the hospital on December 11, 1928, with swelling and pain of both thighs and calves, and a diagnosis was made of double iliac thrombosis. Treated by rest in bed, diet, and elevation of the extremities.

Comment—This patient on her first admission showed a high clotting index and low antithrombin. She was then placed on a high protein diet and readmitted to the hospital three weeks after discharge with a bilateral iliac thrombosis. At her first admission her clotting index was 7 and her antithrombin 7. At her second admission her clotting index was 2, antithrombin 7. On discharge from the hospital after being placed on a vegetable diet, her index had decreased to 1 and her antithrombin raised to 8. It would seem that this patient had a definite high clotting index, and with the administration of a high protein diet developed a double thrombosis.

CASE IX—Mrs S. D., thirty-four years of age, was admitted to the Fifth Avenue Hospital November 22, 1928, with symptoms of left adnexal disease. She was operated on November 24, 1928. Her left ovary was about four times normal in size, polycystic, and the left tube was occluded. The left tube and ovary and appendix were removed. On her eleventh day post-operative she developed a right femoral phlebitis. She was given 50 cubic centimetres of a 5 per cent solution of gentian violet intravenously. The pain in the leg subsided and she was discharged from the hospital on her forty-sixth post-operative day, having had a normal temperature for three weeks. At this time there was no swelling of the leg. No examination had been done on this patient previous to the development of her phlebitis. At the time of her phlebitis her clotting index was 0.9 and her antithrombin 8.

CASE X—L., a woman, twenty-five years of age, who had been a patient of the obstetrical department of the Fifth Avenue Hospital, where she had had a normal delivery. Five days after her return home she developed a left femoral phlebitis. Examination of the blood taken at her home showed a clotting index of 1.2 and antithrombin of 8.

CASE XI—I. L., fifty-seven years of age, was admitted to the Fifth Avenue Hospital November 6, 1928, and operated on November 8, 1928, cholecystectomy, for cholecystitis and cholelithiasis, and appendectomy for chronic appendicitis. On his first post-operative day the patient developed a massive collapse of his right lung. This was treated by turning the patient on his well side and giving him a sharp slap in the back over the affected lung. He immediately had a coughing spell and coughed up several large masses of thick, yellow, tenacious sputum. Following this his temperature subsided. He developed a hæmatoma in his wound, which was opened on his sixth post-operative day, evacuating about half an ounce of old clotted blood. He left the hospital at the end of three weeks. Three days after his return home he had an attack of pain and swelling in his right leg. The leg was cold and swollen, and gave evidence of a phlebitis. A blood test, taken at his home, revealed a clotting index of 0.5, with antithrombin 0.8. He was treated by rest in bed and elevation of the leg. This was a private patient who had no examination of his blood before the development of a phlebitis. The clotting index of 0.5 was normal, but his antithrombin 0.8, showed a diminution and a tendency toward clotting.

All of the above cases had high blood-clotting factors as given by the blood-clotting index or the antithrombin index. In addition to these cases we have had sixty-five patients (a percentage of 33 per cent of all cases

examined) who have had high blood indices, but who have not developed demonstrable thrombosis. If antithrombin is used as the index there have been thirty-six cases (18 per cent of all cases) who are included in this danger group.

In reviewing the histories of these cases we find that many of them have had prolonged post-operative temperatures. There are also included most of our post-operative complications, such as wound infections, post-operative hæmatomas, or where there has been considerable tissue trauma. We believe, therefore, that a certain number of this group may have had deep thrombosis or are potential thrombosis formers.

The following group of cases have shown higher indices than the general run of surgical cases.

TABLE VII

	Total cases examined	Elevated index	Per cent	Diminished anti-thrombin	Per cent
Appendices	29	9	31	7	24
Gall bladders	23	11	48	7	30
Hernias	12	4	33	4	33
Pelvic cases	48	15	31	8	17

In the statistical reports of the incidence of thrombosis and embolism from various clinics ^{10, 11} the four groups enumerated above present the greatest percentage of thrombosis and embolism.

GENERAL COMMENT

The study of the blood-clotting factors in thrombosis and embolism was undertaken because we felt there must be some factor in the blood of patients which predisposes toward clotting, in addition to the factors of trauma, infection and the slowing of the blood-stream which are also present. We felt that to study this problem there must be taken routine examinations of patients' blood pre-operatively, and three and five days post-operatively besides such other determinations as might be decided on. It was obviously impossible to prognosticate what patients might form thromboses before they were operated. Therefore it was necessary to make the routine examinations referred to in order to study the patient's normal and abnormal reactions to surgical procedures. During the course of this work eleven cases of thrombosis, phlebitis or embolism have come under our study. All of these had high blood-clotting factors. Obviously, some cases that were transferred to us from the medical department after the development of thrombosis had no previous examinations. In this series we have had certain disappointments and certain rays of hope. The disappointments have been that we have not as yet simplified the procedure so that it may be made a simple laboratory test, nor have we proved definitely that a patient's tendency toward clotting can be determined pre-operatively. We

feel that routine post-operative examinations may indicate to us a patient's tendency toward thrombosis

The rays of hope resulted from the fact that all cases we have studied with this complication have shown a high index. Two of these cases, II and IV, have shown high indices before the development of phlebitis. Three cases, VI, VII and X, of phlebitis, not anteceded by operative trauma, showed markedly high indices during the active time of their disease. Case VIII, a patient presumably suffering from pellagra, was put on a high protein diet, and had, on first examination, elevated blood-clotting factors. Following her high protein diet she developed thrombosis of both her iliac veins. During this time her clotting factors were increased by diet. Wherever possible we believe that a bleeding diet should be instituted when the clotting factors are high. Obviously in some post-operative cases this is impossible. It may be that some drug, such as heparin, may be utilized to remedy this condition.

One case, V, showed normal clotting both ante-operative and at the last routine examination five days post-operative. On her eleventh post-operative day she developed a thrombosis. This case is disappointing in that at her last examination, five days before the development of her thrombosis, there was no evidence of it in her blood picture. After the development of her thrombosis an examination of her blood showed that her blood-clotting factors had increased.

We recognize that our series is too small to warrant didactic conclusions. We have observed, however, that, after the occurrence of thrombosis and embolism the blood-clotting factors are high. In two cases we believe there has been a definite warning beforehand.

We propose to continue our studies in the hope of finding a single test, such as antithrombin, which may prove to be a satisfactory index of a patient's clotting tendencies. If so, we believe that this test may be so simplified that it could be done daily in post-operative cases as a routine measure. Any diminution of the antithrombin, we believe, should be an indication for the immediate institution, if possible, of a bleeding diet.

Calcium and phosphorus determinations were made on a small series (thirty-three cases), but the variations from normal were so slight that these examinations were discontinued.

ANIMAL EXPERIMENTATION

The following experiments were made on dogs for the purpose of ascertaining the parts played by anaesthesia, trauma, and infection, respectively, in raising the clotting factors of the blood. These experiments were performed through the courtesy of the Laboratory of Surgery at the College of Physicians and Surgeons, Columbia University. The results of these tests on a series of dogs showed their blood-clotting factors were identical with those obtained from patients. The first experiments consisted of anaesthetizing the dogs with ether for one-half hour, testing the blood before and after. The blood was taken by veni-puncture from a large superficial vein.

running obliquely across the outer side of the hind leg. The chart shows a slight raise in the index after anaesthesia, with change appearing in the fibrinogen and platelet factors.

TABLE VIII

Tests Made on Blood Before and After One-half-hour Ether Anaesthesia

Dog	Prothrombin	Fibrinogen	Anti-thrombin	Platelets	Platelet Lysis	Index
No 9949 before	1 11	0 64%	1 16	200,000		0 6
	1 26	0 84%	1 16	270,000		0 9
No 9923 before	1 00	0 64%	1 00	380,000	49%	0 5
	1 00	0 60%	0 95	505,000	54%	0 6
No 9924 before	1 00	0 48%	1 16	300,000	48%	0 4
	1 11	0 54%	1 00	350,000	60%	0 6
No 9988 before	1 00	0 40%	1 16	200,000	40%	0 3
	1 00	0 48%	1 16	200,000	42%	0 4

TABLE IX

Tests Made on Blood Before and After Removal of Appendix Under Ether Anaesthesia

Dog	Prothrombin	Fibrinogen	Anti-thrombin	Platelets	Platelet Lysis	Index
No 9986 before	1 00	0 46%	1 16	165,000	39%	0 4
	1 00	0 46%	1 16	290,000	34%	0 4
No 9987 before	1 45	1 03%	0 91	125,000	32%	1 6
	1 45	1 03%	0 91	platelets	not done	1 6
No 9949 before	2 33	1 03%	0 91	45,000	dog had dis-temper	2 5
	2 33	1 03%	0 91	40,000		2 5
No 9923 before	1 00	0 54%	1 00	420,000	52%	0 5
	1 11	0 64%	0 95	495,000	57%	0 7
No 9924 before	1 11	0 54%	1 16	285,000	46%	0 5
	1 26	0 74%	1 00	300,000	53%	0 9
No 9988 before	1 00	0 40%	1 16	200,000	40%	0 3
	1 45	0 64%	0 91	200,000	50%	0 36

This experiment was then repeated on four dogs, but this time the appendix was removed during the half hour of anaesthesia. The results show that the trauma of such a procedure added practically nothing to the changes produced by anaesthesia alone.

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Dog No 9949 had distemper, which presumably accounted for the marked difference in his figures. The experiment was repeated again, but this time the gall-bladder was removed. The change in clotting factors was similar to those following the removal of the appendix.

After trying out these relatively normal procedures an attempt was made to reproduce acute appendicitis and acute cholecystitis. For this purpose three dogs were anaesthetized and the tips of the appendices were tied off. The blood was tested before and after operation. At the end of twenty-four hours the dogs were then anaesthetized, the wounds opened and the appendices removed. In cases of dogs No 9996 and No 9991 there was a marked rise in prothrombin, fibrinogen and platelets and a drop of antithrombin after the first operation. Microsections of the appendices removed showed gangrene. In the case of dog No 9979 the clotting factors were high at the time of operation. The dog died within twenty-four hours after the procedure and autopsy showed gangrene of not only the appendix but also the caecum and terminal ileum. We believe this to have been caused by tying off the appendix at the base instead of the tip in a dog whose clotting factors were high at the start.

TABLE X

Tests Made on Blood Before and After Tying off Appendix and Before and After Removing Same Appendix at End of Twenty-four Hours

Dog		Pro-thrombin	Fibrino-gen	Anti-thrombin	Platelets	Platelet Lysis	Index
1st operation	before	1.26	0.84%	1.00	120,000	25%	1.0
	after	1.26	0.84%	1.00	140,000	29%	1.0
No 9996							
	before	1.45	0.94%	0.96	250,000	60%	1.4
2nd operation	after	1.45	0.94%	0.95	255,000	62%	1.4
1st operation	before	1.00	0.54%	1.00	140,000	36%	0.5
	after	1.00	0.64%	1.00	150,000	40%	0.6
No 9991							
	before	1.11	1.03%	0.95	270,000	44%	1.2
2nd operation	after	1.11	1.03%	0.95	260,000	46%	1.2
1st operation	before	1.26	1.03%	0.95	160,000	39%	1.3
	after	1.26	1.03%	0.95	200,000	50%	1.3
No 9979							
	before		dog died	within twenty-four	hours		
2nd operation	after						

On Table XI, presented below, are shown the results of our attempt to produce acute cholecystitis. In the case of dog No 9923, the tip of the gall-bladder was tied off and a piece of gauze containing pus from an infected wound on a dog's leg was inserted in it and the opening sutured. After

twenty-four hours the wound was opened and the gall-bladder removed. The results of the two procedures showed a rise in the blood-clotting elements (See table below.) Microsections of the gall-bladder, through the area ligated, showed acute cholecystitis.

The procedure on dog No 9888 varied a little in that the cystic duct and artery were ligated and pus introduced into the whole bladder. The blood picture showed a greater rise in the blood-clotting factors and the sections showed both infection and gangrene of the bladder.

Dogs No 9924 and No 9991 had the tips of the gall-bladders tied off, but

TABLE XI

Tests Made on Blood Before and After Tying Off Tips of Gall-bladder and Before and After Removing Same Gall-bladder at End of Twenty-four Hours

Dog		Pro thrombin	Fibrinogen	Anti thrombin	Platelets	Platelet Lysis	Index
1st Operation No 9923	before	1 26	0 48%	1 00	235,000	49%	0 6
	after	1 45	0 48%	1 00	505,000	58%	0 7
2nd Operation	before	1 45	0 60%	0 91	270,000	60%	0 9
	after	1 26	0 60%	0 95	370,000	59%	0 8
1st Operation No 9888	before	1 11	0 54%	1 16	235,000		0 5
	after	1 45	0 54%	0 95	220,000		0 8
2nd Operation	before	1 45	0 79%	0 87	185,000		1 3
	after	2 33	0 84%	0 87	275,000	51%	2 3
1st Operation No 9924	before	1 26	0 69%	1 16	335,000	40%	0 8
	after	1 26	0 69%	1 16	310,000	37%	0 8
2nd Operation	before	1 26	0 64%	1 00	425,000	41%	0 8
	after	1 26	0 64%	1 00	450,000	40%	0 8
1st Operation No 9991	before	1 11	0 60%	1 00	165,000	39%	0 6
	after	1 11	0 64%	1 00	175,000	43%	0 7
2nd Operation	before	1 11	0 79%	0 95	195,000	38%	0 9
	after	1 11	0 79%	0 95	250,000	44%	0 9

no pus introduced into them. The first of these showed little or no change in the clotting factors, and microscopic sections revealed a congested mucous membrane. Apparently the ligature had not been drawn tightly enough to produce gangrene. The second case, however, showed gangrene, and the figures of the blood tests resembled the first two cases.

PRE-TONSILLECTOMY EVALUATION OF BLOOD-CLOTTING FUNCTION

Among the great number of patients undergoing tonsillectomy there is a group who are definite operative risks and present difficulties if operation is

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performed The clotting-time determination is no index of the clotting function and has been found non-conclusive in an exhaustive study by W M Hunt⁹ On the other hand there is another group whose blood-clotting times have been found increased and are suspected as bleeders Clotting function tests of such patients have been found normal in a number of cases and have thus eliminated them from the category of bleeders

TABLE XII
Pre-Tonsillectomy Analysis of Clotting Components in Suspected Bleeders
(From the Service of W M Hunt, Fifth Avenue Hospital)
Group 1—Patients with Deficient Clotting Function

Name	Clotting time	Bleeding time	Pro-thrombin	Fibrinogen	Anti-thrombin	Platelets	Platelet disintegration	Clotting index	Remarks
S I S	5'0"	4'0"	0 66	0 54%	1 57	250,000	24%	0 2	Hemophilia
D	7'30"	2'30"	0 87	0 42%	1 08	195,000	21%	0 3	Hemophilia
B	6'45"	2'0"	0 13	0 56%	6 8	300,000	10%	0 003	Hemophilia

TABLE XIII
Group 2—Patients with Normal Clotting Function

Name	Clotting time	Bleeding time	Pro-thrombin	Fibrinogen	Anti-thrombin	Platelets	Platelet disintegration	Clotting index	Operation
K	8'15"	2'30"	0 96	0 93%	0 96	180,000	28%	0 9	Tonsillectomy
R	5'0"		1 38	0 74%	0 86	180,000	39%	1 0	Tonsillectomy
F	4'0"	2'0"	1 38	0 59%	1 0	200,000	25%	0 8	Tonsillectomy

TABLE XIV
Group 3—Nutritional Bleeders

Name	Date	Clotting time	Bleeding time	Pro-thrombin	Fibrinogen	Anti-thrombin	Platelets	Platelet Lysis	Index
H		6'45"	6'15"	0 6	0 60%	1 5	175,000	37%	0 1
		5'45"		0 93	0 64%	1 07	150,000	37%	0 3
		6'30"		0 93	0 60%	1 07	190,000	37%	0 4
B		4'30"		0 87	0 46%	1 25	240,000	62%	0 2
		8'0"		0 93	0 28%	1 25	210,000	52%	0 2

CASE DISCUSSION

Group 1.—Five patients appeared for an indicated tonsillectomy The clotting times were normal, and yet the past histories revealed bleeding ten-

dencies from birth The low percentage of platelet disintegration characterized such as hemophiles

Group 2—Four patients appeared for tonsillectomy with histories of having bled readily on bruising (F), or having been denied operation at another hospital because of prolonged clotting time (K) or having a family history of bleeders (R) Clotting function determinations were normal and operation was uneventful in each case

Group 3—Four patients scheduled for tonsillectomy had histories of bleeding readily Clotting function studies showed that previous difficulties in arrestive bleeding in these patients were due to clotting deficiencies correctable by a clotting diet (Vide chapter on Dietary Treatment of Hemorrhagic Diseases)

Case H showed an index of 0.1 which on a clotting diet rose to 0.3 and later to 0.4 The resulting status of Mrs H became more favorable for operation Case B, an interne at the hospital, had an index of 0.2 His tendency to bleeding was associated with his vegetarian dietary Doctor B was advised to adopt a clotting diet, but he failed to keep it up and after operation bled periodically for a week The clotting index remained 0.2 on a persistent vegetarian régime

PRENATAL PREVENTION OF POTENTIAL HÆMORRHAGIC DISEASE OF THE NEW-BORN

True melæna neonatorum is a distinct entity when hæmorrhage from the gastro-intestinal tract and a progressively prolonged clotting time of the blood dominate the entire disease picture of a new-born infant This disease differs from other hæmorrhagic "diatheses" of the new-born secondary to sepsis, thrombocytopenic purpura, congenital lues, congenital anomalies of the viscera and tumors of the abdomen

The clotting time of true melæna is not conclusive for characterizing the hæmorrhagic tendency of a new-born infant At birth the clotting time may be normal, though spontaneous bleedings occur, and the clotting time may be delayed, though there be no hæmorrhage The quantitative determination of the clotting components of the blood indicates the nature of its clotting deficiency and hence the hæmorrhagic status of the infant The blood deficiency of melæna neonatorum is characterized by a marked decrease in the prothombin content of the infant's blood

The hereditary aspect of abnormal bleeding has been restricted to hemophiliacs Other forms of hæmorrhagic disorders may be conveyed from parent to offspring and the transmission not be sex-linked, yet no studies of such disturbances have been made

The blood of the foetus is in equilibrium with the maternal blood Any deviation in the concentration of the clotting components should be manifest in the maternal blood studied early in the course of the pregnancy The evaluation of the blood-clotting function of maternal blood thus offers a basis of prediction of potential hæmorrhagic disease developing in utero Such an early diagnosis is more favorable for prenatal preventive therapy

EVALUATION OF BLOOD CLOTTING FACTORS IN SURGICAL DISEASES

CASE—(Patient of Doctor Tritsch) Mrs T N had five pregnancies, first four of which terminated in death of new-borns with hæmorrhagic disease in three and possibly in the fourth First baby, a girl died about eight hours after birth, second, a boy, was still-born following forceps delivery, third a girl, died within three hours after birth, fourth, a girl, died twenty-two days of age, the present fifth, a boy, is living and normal

The mother and father were negative for lues, focal infections, etc During the fourth pregnancy the mother was toxic and was maintained on a low protein diet The family history was negative, from the standpoint of hæmorrhagic disturbances

TABLE XV
The Clotting Factors of Mrs T N's Blood

Date	Clotting time		Bleeding time	Pro-thrombin	Fibrinogen	Anti-thrombin	Platelets	Lysis Percent	Index
Dec '27				0 31	0 38	1 5	154,000	—	0 071
Mar '28	6'15"	5'15"	4'45"	0 35	0 75	1 4	175,000	37	0 2
May '28	2'30"	1'45"	1'30"	1 12	0 79	0 75	265,000	68	1 3

The Clotting Factors of Mr N's Blood

May '28	3'30"	1'30"	2'00"	0 98	0 46	1 0	255,000	70	0 4
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The Clotting Factors of Baby N

Aug '28	2'15"	1'30"	1'30"	1 0	0 47	1 0	380,000	60	0 5
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The blood of Mrs T N examined the second month of pregnancy showed a somewhat prolonged clotting time by tissue and venous puncture, respectively The prothrombin index was markedly low, 0 31 (normal 1 0), the characteristic finding in true melæna neonatorum The fibrinogen content was low, 0 38 per cent (normal 0 6 per cent) The antithrombin index was somewhat elevated, 1 5, (normal 1 0) The platelets were low, normal 154,000 Hence, Mrs T N's blood at the second month of pregnancy was poor in clotting function and specifically low in prothrombin content, the characterizing deficiency factor in the blood of true melæna The father's blood was normal

The treatment of Mrs T N consisted in an analysis of her nutritional habits in order that her corrected food intake may be balanced and adequate and particularly high in varied proteins (six grams per kilo of body weight) and varied lipins The visceral organs were given because of their protein phospholipin content in this order lung, kidney, testes, brain, heart, pancreas, liver The acid-forming proteins were neutralized by base-forming fruits and vegetables Excess of basic salts are requisite for a positive calcium balance as well as for their favorable effect on prenatal development

DIETARY TREATMENT OF HÆMORRHAGIC DISEASES

The substances involved in the normal clotting of blood when shed are found in relatively constant amounts Deviations from such values favor either bleeding or thrombosing depending on a decrease or an increase in the concentrations of these substances in the blood

The chemical nature of the clotting components has been established as lipins for the platelets originating in the bone-marrow, and globulins for the prothrombin and fibrinogen synthesized in the liver

Lipins and globulins are the source of the blood-clotting substances, initially arising from the daily dietary. This nutritional basis for the composition of blood in clotting substances led us to a dietary treatment for certain hæmorrhagic diseases.

The blood problems studied constituted two large groups—bleeders whose clotting substances were decreased in concentration and those tending to thrombose, in whom the clotting substances were increased in concentration in the patient's blood.

Bleeders found deficient in fibrinogen or prothrombin were maintained on an acid-forming diet high in globulins—a protein intake of about five grams per kilo of body weight.

Bleeders found deficient in platelets were maintained on an acid-forming dietary high in unsaturated lipins, constituting two-thirds of the caloric intake.

Patients whose clotting function index were found to be high were maintained on a base-forming dietary consisting of 0.50 gram kilo body weight, fat as contained in the natural food without addition and increased fluid intake.

Analyses of bleeding diets to decrease clotting function and clotting diets to increase clotting functions are given below.

TABLE XVI
Results with Clotting Diet

Name	Diagnosis	Date	Clotting time	Bleeding time	Prothrombin	Fibrinogen	Antithrombin	Platelets	Platelet disintegration	Clotting Index	Remarks
M	Chronic appendix	7/30	5'30"	1'0"	1 0	Per cent 0 28	1 07	460,000	Per cent 48	0 3	
		8/1	5'30"	1'0"	0 93	0 37	1 0	240,000	44	0 3	
		8/7	3'30"	1'30"	0 93	0 60	1 0	330,000	54	0 6	
		8/9	3'30"	1'30"	0 87	0 54	1 0	225,000	42	0 5	
A	Hypertrophied tonsils	9/17	6'45"		0 60	0 60	1 5	175,000	37	0 2	
		10/16	5'45"		0 93	0 64	1 07	150,000	37	0 5	
		10/31	6'30"		0 93	0 60	1 07	190,000	31	0 5	
N	Children bleeders	3/10	6'15"	4'45"	0 39	0 75	1 4	175,000	37	0 2	
		5/21	2'30"	1'30"	1 37	0 79	0 82	265,000	66	1 3	
S		8/30	4'0"	2'30"	1 54	0 54	0 82	115,000	12	1 0	
		9/17	4'0"	2'30"	1 54	0 69	0 82	205,000	60	1 5	
		10/8	4'0"	2'30"	1 54	0 69	0 82	260,000	61	2 0	

CASE DISCUSSIONS

CASE M was admitted for operation and found to have a low clotting index (0.3) as the result of low fibrinogen. M was put on a clotting diet which doubled the blood fibrinogen and hence brought the clotting index to normal.

CASE H was advised a tonsillectomy, but a long-standing bleeding history made H an operative risk. The prothrombin was low (0.6) and the antithrombin high (1.5). Diet brought the prothrombin and antithrombin to normal with a resultant normal clotting index.

EVALUATION OF BLOOD CLOTTING FACTORS IN SURGICAL DISEASES

CASE N was studied in the Out-Patient Department because of purpuric spots and prolonged bleeding when bruised N showed a low prothrombin (0.39), a high antithrombin (1.4), and low platelets A clotting diet readily brought the blood to a high normal clotting function

CASE S, a girl, thirteen years of age, had a persistent metrorrhagia for four months since the onset of menstruation On a clotting diet, the clotting index rose from 0.1 to 2.0 with a simultaneous cessation of the bleeding

CASE M, a physician's boy, nine years of age, had a typical thrombocytopenic purpura The boy also had a chronic eczema since the sixth month of life and was maintained on an approximate fat-free diet as part of the therapy for the eczema With the onset of purpura and the platelets decreasing to less than 50,000 splenectomy was advised A clotting diet with two-thirds of the calories in fat raised the platelets to 340,000 The boy has been free from purpura or eczema for fifteen months

TABLE XVII
Results with Bleeding Diet

Name	Diagnosis	Date	Clotting time	Bleeding time	Prothrombin	Fibrinogen	Antithrombin	Platelets	Platelet disintegration	Clotting	
						Per cent			Per cent		
W	Partial nephrectomy for double pelvis of kidney	5/11	4'15"	1'30"	1.38	1.12	1.00	380,000	65	1.5	
		5/14	4'30"	2'0"	1.00	0.56	1.04	370,000	60	0.5	
		5/21	3'15"	1'30"	1.54	0.69	1.04	420,000	66	1.1	
F	Cystic ovary, chronic appendix	7/26	3'30"	2'0"	0.93	0.56	1.25	500,000	49	0.4	
		8/2	3'15"	2'0"	1.38	0.75	1.00	360,000	59	1.0	
		8/4	4'0"	2'0"	1.38	1.03	0.75	350,000	65	1.8	
		8/7	4'0"	2'0"	0.93	0.46	1.07	265,000	47	0.4	

CASE W, a woman, was admitted for removal of an extra lobe of the left kidney Five days post-operative her clotting index was found to be high and she was put on a bleeding diet In three days' time the index went from 1.5 down to 0.5 She was then put back on a diet containing protein, and after a week her blood index had risen again to 1.1

CASE F was operated on for cystic ovary and chronic appendix Pre-operative index was 0.4 Following the operation her index rose to 1.0 and 1.8 After three days on a bleeding diet her index dropped to 0.4 again

DIETARY STUDIES ON ANIMALS

Studies were made on four dogs of the relations between diet and the blood-clotting factors The animals were maintained on a bleeding diet for forty-eight hours Blood determination at the end of this period showed a decrease in the clotting factors and index They were then fed a clotting diet for forty-eight hours, with a definite rise over normal of the clotting factors and index The details are given in table XVIII

CONCLUSIONS

1 The present studies were undertaken to determine the reaction of the blood-clotting factors to surgical procedures, and to surgical diseases, such as thrombosis and embolism and certain bleeding diseases

2 The methods of determination of the substances involved in blood coagulation are presented, *i e*, prothrombin, fibrinogen, antithrombin, platelets, and the degree of platelet lysis

TABLE XVIII

Tests Made on Blood After (1) Normal Diet, (2) After Forty-eight Hours on a Carbohydrate and Vegetable Diet, (3) After Forty-eight Hours on a Visceral Diet

Dog		Pro thrombin	Fibrin- ogen	Anti- thrombin	Platelets	Index
No 9949	Normal diet	1 11	0 64%	1 16	200,000	0 6
	Carbohydrate and Vegetable diet	1 11	0 64%	1 16	200,000	0 6
	Protein diet	1 45	1 12%	0 95	250,000	1 7
No 9923	Normal diet	1 00	0 54%	1 00	400,000	0 5
	Carbohydrate and Vegetable diet	0 74	0 54%	1 16	220,000	0 3
	Protein diet	1 00	0 64%	0 95	300,000	0 7
No 9924	Normal diet	1 11	0 64%	1 16	220,000	0 6
	Carbohydrate and Vegetable diet	1 11	0 28%	1 00	135,000	0 3
	Protein diet	1 26	0 69%	1 00	210,000	0 9
No 9888	Normal diet	1 00	0 40%	1 16	200,000	0 3
	Carbohydrate and Vegetable diet	1 00	0 40%	1 16	325,000	0 3
	Protein diet	1 11	0 64%	0 95	330,000	0 7

3 The index of blood-clotting function is a value calculated from the composition of the clotting components

4 A classification of diseases in which the blood-clotting function is altered is given

5 Eleven cases of proven thrombosis, phlebitis or embolism have been studied. All of these cases had a high clotting index and a low antithrombin. In addition a small percentage of post-operative cases, not proven to have thrombosis or embolism, showed high clotting factors.

6 Animal experiments have shown an increase in the clotting factors following post-operative infection and gangrene, and a lesser increase following ether anaesthesia.

7 Pre-tonsillectomy studies of the clotting function are given for three groups of cases (a) with deficient clotting function, (b) with normal clotting function, previously suspected as bleeders, (c) nutritional bleeders treated by diet.

8 The prenatal prevention of potential hæmorrhagic disease of the new-born is given with a case report of a woman who gave birth to four previous infants with true melæna neonatorum.

9 The dietary treatment of hæmorrhagic diseases is presented. Analyses of diets are given for increasing clotting function (clotting diets) and for decreasing clotting function (bleeding diets). Animal experiments show that the tendencies to bleed or clot are definitely influenced by diet.

Case reports are presented with results obtained on bleeding and clotting diets.

10 This is a preliminary report. Studies are being continued.

EVALUATION OF BLOOD CLOTTING FACTORS IN SURGICAL DISEASES

APPENDIX

Diet to Increase Clotting Function of the Blood

Diet to Increase Clothing Function of the Blood									
Calories 1000	Protein 8 gm per kilo 20 per cent		Fat $\frac{2}{3}$ of calories 12 per cent		Water low 68 per cent		Acid high		
CHILD	P 20 gm	C 33 gm	F 75 gm		H ₂ O 435 c c				
Food	Measure- ments	Pro- tein	Car- bon	Fat	Calcium	Acid	Base	Vitamin	H ₂ O
<i>Breakfast</i>									
Stewed fruit (fresh)	4 tbsp	2	3 8	2	18 3		2 01	ABC	18
Evaporated milk	2 tbsp	3 8	4 5	3 7	66 8		7	ABCDEG	27
Egg	1	6 7		5 3	76 8	5 55		ABDEG	37
Bacon	2 strips	2 1		13 0	129 5	*		AB	4
Whole wheat bread	1 slice	9	5 2	1	25 9	3		AB	4
<i>Dinner</i> ¹									
Potato	4 tbsp	1 0	8 4		38 5		2 8	ABC	30
Butter	2 pats	2		17	158 9			ADG	1
Liver		19 0		5 3	123 7	*			73
Milk	$\frac{1}{2}$ glass	3 3	5	4 0	71 2		1 81	ABCDEG	87
<i>Supper</i>									
Brain		8 8		9 3	118 9	*			81
Spinach	Small serving	8	2 3	2	14 6		16 20	ABC	54
Egg yolk	1	3 1		6 7	75	5 33		ABD	1
Bone-marrow		2		9 2	83 6		*		
Stewed fruit (fresh)	4 tbsp	2	3 8	2	18 3		2 01	ABC	18
		13 1	6 1	25 6	310 4				435

Diets to Increase Clotting Function of the Blood

Calories 1000	Protein 5 2 per kilo 25 per cent	Fat ½ of calories 25 per cent	Water low 50 per cent	Acid reaction					
	P 61 gm	C 64 gm	F 55 gm	H ₂ O 565 c c					
Food	Measure- ments	Pro- tein	Car- bon	Fat	Calcium	Acid	Base	Vitamin	H ₂ O
<i>Breakfast</i>									
Stewed fruit	2 tbsp	4	6 6	2	30 6		1 6	ABC	17
Eggs	2 yolks	6 2		13 4	150	10 7		ABD	18
Bacon	1 strip	1 1		6 5	65	5		AB	2
Toast	1 slice	9	5 2	1	25 9	3		AB	5
Milk	1 cup	7 8	12	9 6	170 8		5 5	ABCE	208
<i>Dinner</i>									
Potatoes	1 small	1 1	9 5		43 4		3	ABC	34
Butter	1 pat	1		4 3	40 1			AB	4
Beef, scraped	2 tbsp	9		1 1	48	5		ABC	28
Cream cheese	¼ cake	5 2	5	6 7	83	1 1		AB	7
Stewed fruit	2 tbsp	4	6 6	2	30 6		1 6	ABC	17
<i>Supper</i>									
Asparagus	Serving	8	2 3	2	14 6		5	ABC	54
Cauliflower	Serving	8	2 3	2	14 6		3 1	AB	55
Liver	Serving	22 4	2 4	4 2	120 8	*		ABC	69
Bread (stale)	1 slice	9	5 2	1	25 9	3		AB	5
Butter	1 pat	1		4 3	40 1			AB	4
Custard	⅓ cup	4 3	11	4 3	100		3 2	ABCDEG	38
		61 5	63 6	55 4	1003	17 9	18 5		

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Diets to Increase Clotting Function of the Blood

Calories 1000	Protein 5.2 per kilo	Fat 1/2 of calories	Water low	Acid reaction					
	31 per cent	35 per cent	34 per cent						
	P	C	F	H ₂ O					
CHILD—12 kilo	78 gm	88 gm	37 gm	708 c c					
Food	Measure-ments	Pro-tein	Car-bon	Fat	Calcium	Acid	Base	Vitamin	H O
<i>Breakfast</i>									
Fruit (stewed)	4 tbsp	2	8.5	3	38.5		2.2	ABC	51
Sugar	Scant tbsp		5		20.5				
Eggs	2	13.4		10.5	152.6	11.1		ABD	73
Rice (boiled)	2 tbsp	8	7.3		33.2	2.8		B	22
Milk	1 cup	7.8	12	9.6	170.8		5.5	ABCE	208
Toast	1 slice	9	5.2	1	25.9	7		AB	5
<i>Dinner</i>									
Green Vegetables									
Cauliflower	4 tbsp	8	2.3	2	14.6		3.2	ABC	55
Asparagus	4 tbsp	8	2.3	2	14.6		5	ABC	56
Beef (scraped)	Serving	23		2.5	114.5	13.9		AB	70
Bread (stale)	1 slice	9	5.2	1	25.9	7		AB	5
Custard	1/3 cup	4.3	11	4.3	100		3.2	ABCE	
Liver	Serving	22.4	2.4	4.2	120.8	*		ABC	69
Potatoes	3 tbsp	1.1	9.5		43.4		1.5	ABC	34
Butter	1 pat	1		4.3	40.1			AB	4
Bread	1 slice	9	5.2	1	25.9	7		AB	5
Fruit (stewed)	4 tbsp	3	7.6	2	34.3		9	ABC	51
Sugar	Scant tbsp		5		20.5				
		77.7	88.5	36.6	996.2	29.9	17.0	ABCDE	708

* Acid—No analyses

Equivalents	Wt in gm	Pro gm	Fat gm
<i>Meat</i>			
Beef, scraped	100	23	2.5
Brain	100	8.8	9.3
Caviar	100	30	7.6
Cheese (full cream)	100	25.9	33.7
Chicken (white meat)	100	17.6	7.6
Egg yolk	100	15.7	33.3
Fish (halibut)	100	18.6	5.2
Kidney	100	13.7	1.9
Liver (chicken)	100	22.4	4.2
Liver (veal)	100	19	5.3
Lungs	100	16.4	3.2
Sweetbread	100	16.8	12.1
Tongue	100	18.9	9.2
<i>Fat</i>			
Bacon	100	10.5	61.8
Bone-marrow	100	2.2	98.8
Butter	100	1	85
Chicken fat	100		100
Cod-liver oil	100		100
Goose fat	100		
<i>Nut and Nut Products</i>			
Almonds	100	21	54.9
Brazil nuts	100	17	66.8
Peanuts	100	25.8	38.6
Peanut butter	100	29.3	17.1
<i>Vegetable Food</i>			
Beans, dry	100	22.5	1.8
Beans, green	100	4.7	3.8
Beans, lima, dry	100	18	1.5
Beans, lima, green	100	3.2	3
Lentils, dry	100	25.7	1.0
Peas, dry	100	24.6	1.0
Peas, green	100	7.0	5

EVALUATION OF BLOOD CLOTTING FACTORS IN SURGICAL DISEASES

Diet to Increase Clotting Function of the Blood

Calories 2000	Protein 5 gm per kilo	Fat 2/3 calories	Water low	Acid reaction					
	18 per cent	16 per cent	66 per cent						
	P	C	F	H ₂ O					
ADULT	90 gm	80 gm	148 gm	817 c c					
Food	Measure-ments	Pro-tein	Car-bon	Fat	Calcium	Acid	Base	Vitamin	H.O
<i>Breakfast</i>									
Stewed fruit (dry)	4 tbsp	9	20 7	4	90		2 01	ABC	18
Cooked cereal	6 tbsp	2 5	10	1 1	59 9	1 9		ABE	1
Bacon	3 strips	3 2		19 4	174 6	?		AB	6
Liver	Serving	23 8		6 6	154 6	?			91
Coffee									
Cream 20 per cent	1/4 cup	1 5	2 7	11 1	116 7			ABCE	44
<i>Dinner</i>									
Peas		3 6	9 8	2	55 4		1 3	ABCDE	85
Celery		1 3	3 9	3	23 5		7 8	ABC	93
Butter	1 pat			8 5	76 5			ABG	1
Sweetbread	Serving	25 2		18 1	263 7				105
Chicken fat	2 tbsp			15 0	135 0				
Lettuce		6	1 5	2	10 2		3 7	ABCDEG	47
Oil				10	90				
Stewed fruit	1/3 cup	6	10 2	4	46 8		5 4	ABC	64
<i>Supper</i>									
Whole wheat bread	1 slice	9	5 2	1	25 9	3		AB	3
String beans		1 3	3 9	3	24 1		5 4	ABC	93
Butter	1 1/2 pats	20 6	6	12 8	115 2				
Kidney		20 6	6	2 9	110 9	?		ADG	94
Bone-marrow		5		18 6	169 4				
Stewed fruit (fresh)		6	10 2	4	48		3	ABC	64
Nut meats (Brazil)		5 1	2 1	20	208 8				1
		92 2	80 8	146 4	1999 2				817

Diets to Increase Clotting Function of the Blood

Calories 2000	Protein 2 6 gm	per kilo	Fat 1/3 calories	Water low	Acid reaction				
	36 per cent	27 per cent	37 per cent						
	P	C	F	H ₂ O					
ADULT—70 kilo	178 gm	135 gm	82 gm	1242 c c					
Food	Measure-ments	Pro-tein	Car-bon	Fat	Calcium	Acid	Base	Vitamin	H ₂ O
<i>Breakfast</i>									
Stewed fruit	Serving	8	20 1	6	87 1		5 4	ABC	127
Eggs	2	13 4		10 5	152 6	11 1		ABDEG	74
Liver (chicken)	Serving	22 4	2 4	4 2	120 8	*		ABEG	69
Toasts	2 slices	1 9	10 4	2	52 3	6		AB	10
Milk	1 cup	7 9	12	9 6	170 8		5 5	ABCDEG	208
<i>Dinner</i>									
Lentil soup									
Milk	1 cup	7 9	12	9 6	170 8		5 5	ABCDEG	208
Lentils	1/3 cup	13	30	5	176 5	2 5			4
Chicken (white meat)	Serving	35 2		15 2	285 6	21 4		ABEG	120
Vegetables	Serving	8	2 3	2	14 6		6 5	ABCDEG	57
Bread	2 slices	1 7	10 4	2	52 3	6		AB	10
<i>Supper</i>									
Caviar	1 tbsp	3	7	2	32 8	*			4
Celery	Serving	7	2	2	12 9		3 9	ABC	48
Cream cheese	1/2 cake	10	1	13 5	165 5	2 2		AB	14
Saltines	2	1 1	6 9	1 3	44 9	8			1
Beef (broiled)	Serving	56 6	2	13 5	348 7	33 4		ABEG	168
Potato	Small	2	16 7	1	77 6		5 6	ABC	57
Stewed fruit	1/3 cup	3	10 6	4	48 4		2 8	ABC	63
		178 9	137 7	81 8	2014 2	72 6	35 2		1242

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Diets to Decrease Clotting Function of the Blood

Calories 1000 Protein $\frac{1}{4}$ gm per kilo Fat only in natural foods Basic reaction

Water high

7 per cent 70 per cent 23 per cent
P C F H₂O
CHILD—12 kilo 17 gm 173 gm 25 gm 770 cc

Food	Measurements	Protein	Carbon	Fat	Calcium	Acid	Base	Vitamin	H O
<i>Breakfast</i>									
Stewed fruit (fresh)	5 tbsp	8	12 7	5	60		3 7	ABC	85
Cereal (cooked)	3 tbsp	1 3	5	5	30	I		ABCE	7
Honey	1 tbsp	1	24 4		100			AB	5
Milk	1 cup	7 9	12	9 6	170 8		4 3	ABCDEG	208
<i>Dinner</i>									
Green Vegetables									
Spinach	2 tbsp	4	1 2	1	7 5		8	ABC	28
Cauliflower	2 tbsp	4	1 2	1	7 5		1 6	AB	28
Tomatoes	1 small	4	1 2	1	7 5		1 4	ABC	24
Butter	$\frac{3}{4}$ pat	1		6 4	58 8			ABDG	1
Potatoes	1 small	2 5	21	1	96 9		7	ABC	76
Stewed fruit (fresh)	5 tbsp	8	12 7	4	60		3 7	ABC	85
Honey	1 tbsp	1	24 4		100			AB	5
<i>Supper</i>									
Green Vegetables									
Asparagus	2 tbsp	4	1 2	1	7 5		2	B	28
Carrots	2 tbsp	6	2 7	1	14 5		3 2	ABC	26
Cabbage	2 tbsp	4	1 2	1	7 5		1 8	ABC	27
Butter	$\frac{3}{4}$ pat	1		6 4	58 8			ABDG	1
Rice	$\frac{1}{4}$ cup	1 7	14 6	1	67 8	5		B	44
Fruit	5 tbsp	8	12 7	4	60		3 7	ABC	85
Honey	1 tbsp	1	24 4		100			AB	5

Diets to Decrease Clotting Function of the Blood

Calories 2000 Protein 25 per kilo Fat low Basic reactions Water high

5 per cent 75 per cent 20 per cent

P C F H₂O
ADULT—70 kilo 18 gm 360 gm 47 gm 1176 cc

Food	Measurements	Protein	Carbon	Fat	Calcium	Acid	Base	Vitamin	H O
<i>Breakfast</i>									
Fresh fruit	Generous serving	2	31 8	1 2	150		14	ABC	217
Honey	2 tbsp	2	48 7		200			AB	11
Cereal	6 tbsp	2 5	10	1 1	61	2		ABCE	14
Cream	2 tbsp	8	1 4	5 5	60 3			ABCE	22
Coffee and sugar	2 tbsp		25		100				
<i>Dinner</i>									
Spinach	Serving	1 3	3 9	3	24		27	ABCG	92
Celery	Small serving	7	2	2	12 9		3 9	ABC	48
Potato	Small	1 9	15 7	1	73 1		5 25	ABC	59
Butter	2 pats			17	158			ABDG	2
Fruit	Generous serving	2	31 8	1 2	150		14	ABC	217
Honey	2 tbsp	2	48 7		200			AB	11
Tea and Sugar	2 tbsp		25		100				
<i>Supper</i>									
Asparagus	Serving	1 3	3 9	3	24		8	B	94
Cauliflower	Serving	1 3	3 9	3	24		5 3	AB	92
Butter	2 pats			17	158			ABDG	2
Tomatoes—raw	Small serving	7	2	1	12 9		2 8	ABC	48
Lettuce—raw	Small serving	7	2	1	12 9		3 7	ABCDEG	48
Fruit	Generous	2	31 8	1 2	150		14	ABC	200
Honey	2 tbsp	2	48 7		200			AB	11
Tea and Sugar	2 tbsp		25		100				
									1176

Butter perhaps less, but will increase protein above 25

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HYPERGLYCEMIA FOLLOWING HEAD INJURIES

AN EXPERIMENTAL CLINICAL STUDY*

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EVER since Claude Bernard's¹ discovery in 1855, that a puncture of the tip of the calamus scriptorius will cause hyperglycemia and glycosuria, the possibility of a neurogenic diabetes has been discussed again and again. Leading authorities in diabetes, such as von Noorden, Joslin, Umber, have always held that diabetes is unthinkable without a pancreatic lesion. Following the mass experiment of the World War, in which the large number of head and peripheral nerve injuries have not resulted in any increase of diabetes among the injured, von Noorden² stated that neurogenic diabetes is a myth. Joslin³ corroborated his view on the basis of extensive statistics. Nevertheless the medicolegal question of responsibility for diabetes in patients who have suffered head injuries is frequently raised. In previous editions of his book, von Noorden² has acknowledged traumatic diabetes before a court if

1. Urine analysis was available and found negative before and positive within the first twelve months following the injury.

2. If an individual in good health lost weight and strength following the injury and showed clinical signs and symptoms of diabetes even if the urine has not been tested before and immediately after the injury.

He has even admitted the possibility of traumatic diabetes if a seemingly well man developed the disease within the first and second year following an injury. As it is not necessary for a diabetic to show glycosuria in all samples, the first few urine examinations following the injury may not have contained sugar.

These extremely liberal requirements were followed in certain courts in spite of the fact that gradually less and less belief in a true traumatic diabetes prevailed. On the other hand, a great number of case reports of traumatic glycosuria have been collected by Naunyn,⁴ Higgins and Ogden,⁵ and many others. Only the recent cases cited in von Noorden's and Joslin's monographs, and the studies of Konjetzny and Wieland⁶ and Davidson and Allen⁷ have reported blood sugar determinations following injuries. The former group found a transient glycosuria, lasting three to five days, in 42.4 per cent following fractures of long bones, and an alimentary glycosuria following the oral administration of fifty grams of dextrose in 11 per cent of their fracture cases. Three patients, who knew nothing of their diabetes, sustained fractures and at the first urine examination sugar was found which

* Read before the Chicago Surgical Society, February 3, 1928.

persisted. All three came to autopsy later and typical liver and pancreatic cirrheses were found.

Davidson and Allen⁷ have made sugar tolerance studies of patients suffering from concussion of the brain and skull fractures, using twenty-five grams of dextrose intravenously for testing sugar tolerance. The average fasting blood sugars after concussions and skull fractures were found to be normal but the *sugar curves were high and delayed in returning to normal*. Subsequent observations showed that the abnormal curves did not persist. They believe that the more serious the injury, the more striking was the alimentary hyperglycemia.

Purpose and Scope of This Study—We have studied the question of hyperglycemia following head injuries to answer, if possible, the following questions:

1. How often does hyperglycemia follow a head injury?
2. How long does the disturbance in carbohydrate metabolism last and may it gradually go into diabetes?
3. If this disturbance is of nervous origin, how can it be tested, and can the test be used in determining the presence of residual damage following injury to the brain?

Methods of Animal Experiments—First Series Ten healthy dogs, used to kennel life and fed on the usual diet, which maintains an ample glycogen storage of the liver † were hit on the vortex of the head with a wooden hammer. The dogs were stunned by the blow and remained unconscious from five to twenty minutes. They all passed urine, and most of them defecated. They showed muscular rigidity with twitchings. In our first experiment we laid stress on obtaining signs of basal skull fractures, such as bleeding from the nose, mouth or ears. X-rays were taken of the skulls of these dogs to demonstrate the fracture. Later we found that a loss of consciousness was all that was necessary to obtain changes in the blood sugar and that a fracture was not essential.

Dogs were fasted twenty-four hours before the injury. Samples of blood were taken immediately before and one-half, one, two and three hours after the injury from the saphenous vein. The samples were immediately precipitated and the blood sugar was determined by the Folin-Wu method. Hæmoglobin determinations were made in some cases to determine possible changes in the concentration of the blood.

Chart I shows the ten curves, in which with the exception of one dog all show a marked rise of blood sugar. It was not possible to afflict the same degree of injury on all dogs, and this factor, aside from the individual response, must also be taken into consideration.

Second Series Ten healthy dogs were submitted to a bilateral division of the splanchnic nerves. The operation was performed under morphine-

† Glycogen determinations were made for other purposes in such dogs. From 5 to 6 per cent glycogen was found by the Pfleger method.

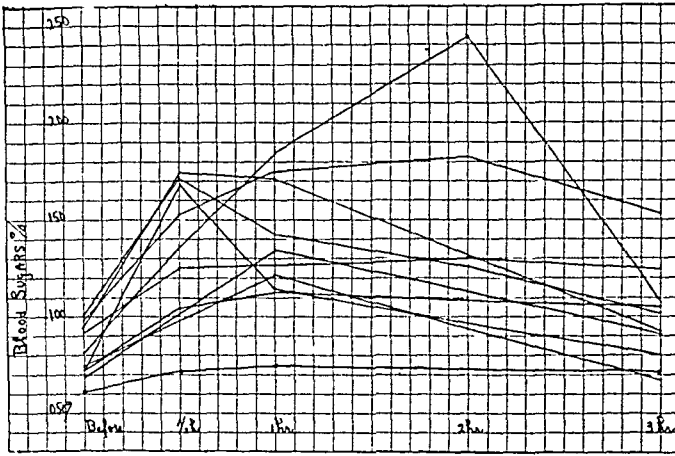


CHART I - Blood sugar determinations on dogs, at short intervals, following head injury

splanchnic nerve in man. Not less than ten days after the operation, when the animal fully recovered, the head injury as described was performed and samples of blood were taken at the same intervals as in the first series.

Chart II illustrates the blood sugar curves after the splanchnics have been cut. In not one instance has there been a rise above 100 milligrams per 100 cubic centimetres of blood, which is well below the upper limit of normal.

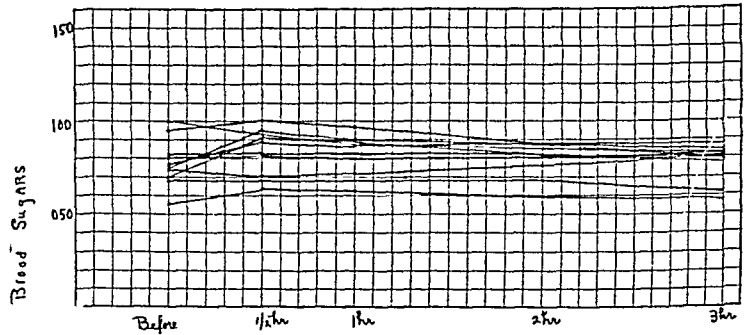


CHART II - Blood sugar determinations following head injury. Splanchnics have been previously cut.

In Chart III the averages of the two foregoing curves have been drawn,

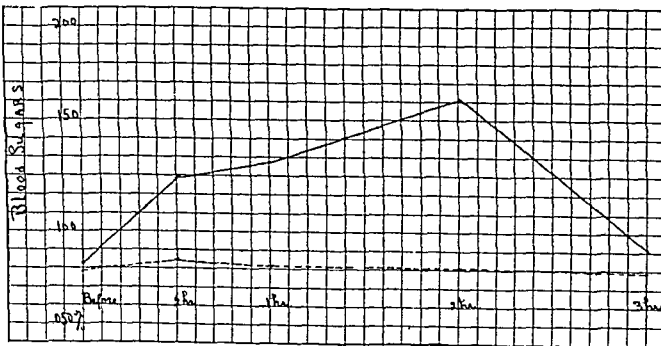


CHART III - Average curves illustrating the effect of splanchnic block on hyperglycemia following the head injury. Straight line (—) before section of the splanchnics. Dotted line (·····) after section of the splanchnics.

atropin-ether anaesthesia. A mid-line incision was made just below the xyphoid cartilage and the splanchnic nerves were exposed between the posterior crus of the diaphragm and the adrenals in the retroperitoneal space. Care was taken not only to cut the main trunk but also some smaller fibres, which correspond to the lesser

which forcibly illustrate the effect of splanchnic block on the traumatic hyperglycemia.

Third Series Six dogs were given 2.5 grams of glucose per kilogram body weight in 20 per cent solution intraperitoneally to determine their blood sugar tolerance. The dogs were then submitted to the head injury and their

sugar tolerance again determined nine or ten days following the injury.

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Chart IV compares the average of the sugar tolerance curves. While the peak is much higher after the injury, after one hour the figures are almost identical.

Methods of Clinical Research—All head injury cases admitted to the service of one of us (Dr H E Mock) at St Luke's Hospital had the following tests:

1 Five cubic centimetres of blood were taken on admission, usually within an hour after the injury.

2 Other samples were taken, if possible three, six, and twenty-four hours following the injury. During this period the patients were

unconscious, and received only small amount of fluids and absolutely no carbohydrates.

3 Within a week following the injury, an epinephrin hyperglycemia curve was determined. After twelve hours of fasting, a sample of blood was removed. One cubic centimetre of epinephrin 1:1000 was injected subcutaneously and further samples were taken at one-half, one, two, and three hours. The reason for substituting the epinephrin response for a sugar tolerance test will be discussed later.

As the patients arrived at the hospital at all hours of the day and night it was found helpful to use a preservative instead of the potassium oxalate. The blood samples were preserved in a mixture of sodium fluoride ten grams, thymol one gram, adding about five centigrams to five cubic centimetres of blood. The blood was kept in the ice box and determined together with the three, six and twenty-four hour samples within forty-eight hours. Repeated checks showed that the preservative was efficient and maintained the sugar level for several days. The method has been used extensively by Nadler and Starr⁸ in determining blood sugars from out-of-town diabetics. It was to be expected, that higher blood sugar levels would drop more readily, but this was not the case in our experience.† The following example illustrates the efficiency of preservation.

Immediate precipitation 0.151 per cent

Twenty-four hours in ice box 0.156 per cent

Six days in ice box 0.156 per cent

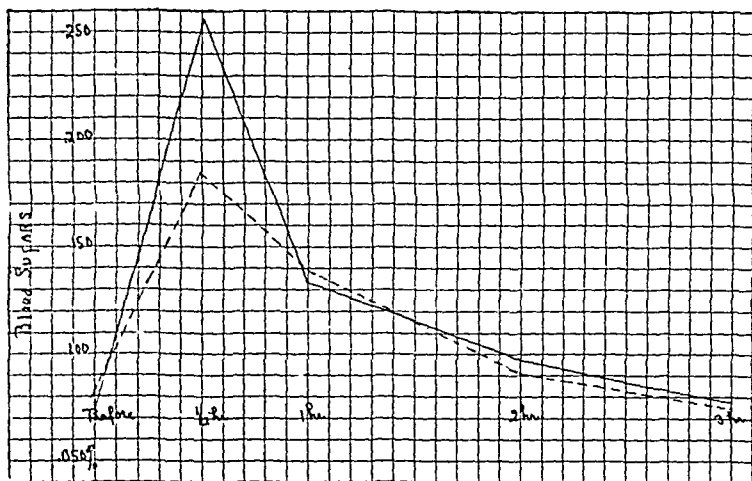


CHART IV—Sugar tolerance curves before and within ten days following the head injury. 2.5 grams glucose per kilo weight in 20 per cent solution was injected into the peritoneal cavity. Dotted line () before, straight line (—) after the injury.

† Exton doubts whether this method is reliable. For our purposes this method proved very satisfactory.

TABLE I
Blood Sugar Determinations Within Twenty-Four Hours Following the Head Injury

Patient	Age	Sex	Clinical Diagnosis	X-ray	1 Hour* Per cent	3 Hours* Per cent	6 Hours* Per cent	24 Hours* Per cent
R S	29	F	Suspected skull fracture conscious	Negative	100		125	121
L N	22	M	Fracture of temporal bone	Confirmed		120	121	91
H F	39	M	Basal skull fracture	Linear fracture of frontal and sphenoid bones	149		122	75
T D	25	M	Suspected skull fracture cussion	Negative		129	131	92
S R	22	F	Depressed frontal fracture ture of nasal bones	Comminuted fracture left	220	183	157	139
C H	25	M	Fracture of anterior fossa	Linear left temporal fracture		165	120	115
H P	37	M	Suspected fracture Concussion	Negative		151	143	110
F G	31	F	Fracture of anterior fossa	Linear fracture of orbit			129	115
F N	48	F	Basal skull fracture	Left frontal and fracture sphenoid		140	128	110
M D	50	F	Fracture of anterior fossa	Fracture of left frontal and temporal bones	153	153	181	181

* Hour designates time elapsed between injury and determination of blood sugar

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Results of Clinical Investigation—Single samples taken from patients within the first twenty-four hours Ten patients were examined It is true that the first sample was not a fasting blood sugar, as patients had eaten before the injury Subsequent samples however also showed elevations of the blood sugar in spite of the precautions described above Red-cell counts and hæmoglobin determinations did not show such elevations as to account for the high sugar values by dehydration Table I summarizes our findings All patients had a higher sugar level than a few days later from which we can reasonably deduct that their blood sugar before the injury was also normal It must be noted that all patients had lost consciousness, while not all of them had a proven fracture

Epinephrin Curves Within a Week Following the Injury—Ten epinephrin curves are available It was to be expected that great individual differences would occur, on the basis of which patients could be divided into epinephrin susceptible and non-susceptible individuals All curves, however, taken on control cases, showed a peak within an hour, the maximal rise not exceeding 100 per cent of the original fasting value Furthermore, the sugar level came back to normal at the end of three hours

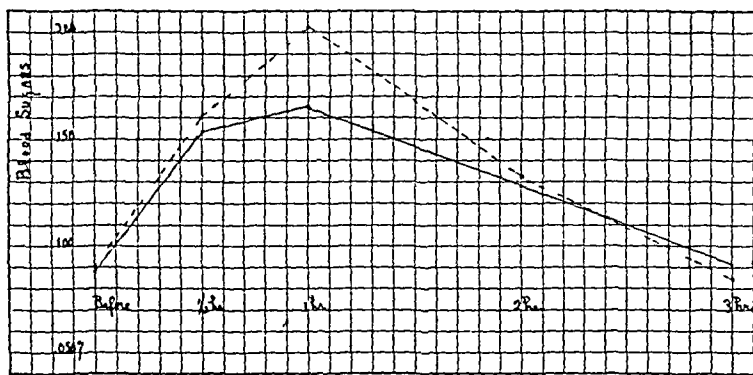


CHART V—Epinephrin hyperglycemia curves in man One cubic centimetre of 1:1000 epinephrin was injected subcutaneously Straight line (—) average of five determinations on normals Dotted line (.....) average of nine determinations within a week following the head injury

Chart V illustrates an average of five determinations in normals compared with epinephrin curves taken within ten days following the injury

Of the ten epinephrin curves taken on patients one week following the head injury eight showed a rise above 100 per cent One case, however, showed in addition a delay in return to normal

Mrs Mary D, fifty years of age, received a linear fracture of the left frontal and temporal bones on November 23, 1927 Her blood sugar values within the first twenty-four hours are shown in Table I in the last column It can be seen that at twenty-four hours the blood sugar was still 0.181 per cent Six days later her epinephrin curve was the following (Chart VI) While the peak is just 100 per cent of the fasting value, the descending limb of the curve is very gradual At the end of three hours the sugar level is still 45 per cent above the starting point She was discharged with a ptosis of the left upper eyelid and while the ptosis still persists could not be examined since she has refused to allow further blood studies

This patient had an unusually long hyperglycemia following the head injury Furthermore, her delay in bringing the epinephrin hyperglycemia down to normal may indicate a pancreatic insufficiency

Epinephrin Curves Several Months or Years After the Head Injury—
Eight patients were available for study. Of these, three patients gave a rise

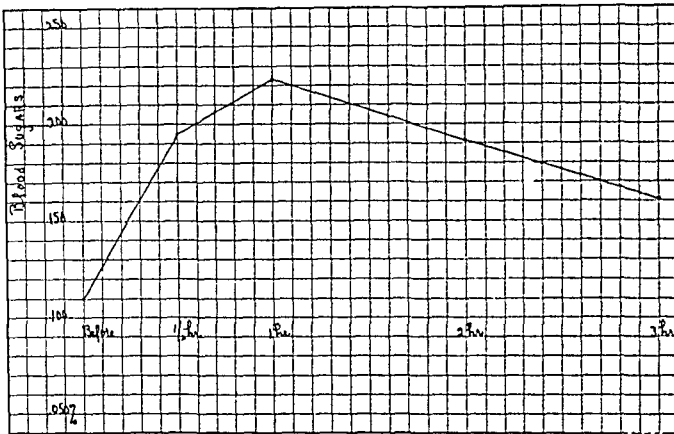


CHART VI—Epinephrin curve six days following fracture of the anterior fossa. Mrs. M. D., aged fifty. Marked delay in returning to initial level.

in blood sugar above 100 per cent. Chart VII shows their epinephrin curves with the salient data of their residual symptoms, all show a rise above 100 per cent. However, in two cases the sugar level rose only very slightly and did not return to normal in three hours (Chart VII).

*Comment—*The interruption of an efferent impulse from the brain to

the liver could be uniformly established by section of the splanchnic nerves. The pathway of stimulation following Claude Bernard's *piquûre* has already been established by Claude

Bernard himself and later amplified by Eckard.⁹ According to Freund and Marchand, Stewart and Rogoff,¹¹ the *piquûre* hyperglycemia is effected by an action of the sympathetic fibres in the liver so that the presence of adrenals is not absolutely necessary although they play an important rôle in the normal animal.¹² The *piquûre* centre has been more closely analyzed by the studies of Brugsch, Diesel and Levy,¹³ who found that the origin of sympathetic impulses con-

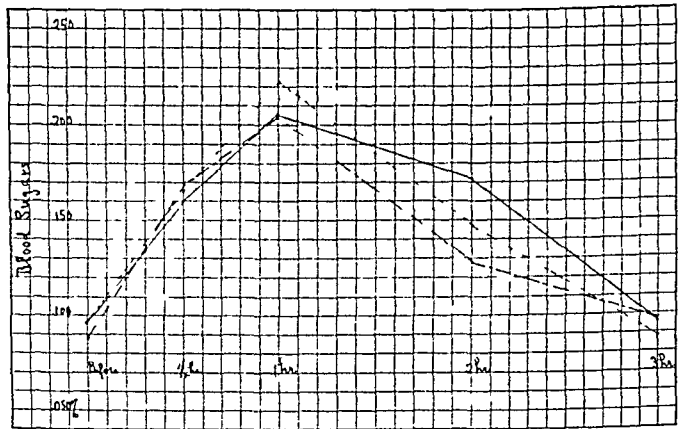


CHART VII—Epinephrin curves of three patients several months following the head injury. All three had residual symptoms. Note the rise above 100 per cent at the first hour and the normal return. Straight line (—) Lillian K., aged twenty-nine. Basal skull fracture sixteen months previously. Occasional headache, ptosis of right upper eyelid, limited upward rotation of right eye. Right pupil larger than left. Dotted line (···) Stella H., aged twenty. Basal skull fracture twenty-two months previously. Occipital and left temporal headache. Total deafness left ear. Otherwise negative. Interrupted line (— — —) Dorothy R., aged twenty-five. Linear fracture at base three months previously. Occipital headache at times. No other residual symptoms.

cerned in *piquûre* hyperglycemia was in the dorsal third of the vagal nucleus. If the anterior part of this nucleus were injured, a hypoglycemia resulted. Thus the dorsal portion of the nucleus of the vagus is a centre for blood sugar regulation. Aschner¹⁴ injuring the hypothalamus could also produce glycosuria. This centre is probably identical with the sympathetic centre of Karplus and Kreidl¹⁵ in the hypothalamus. Further centres for blood sugar regulation

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are claimed to be present in a nucleus around the third ventricle (nucleus periventricularis) and the highest one in the corpus striatum¹⁶ Experiments of Morita¹⁷ would indicate that the removal of both hemispheres has no influence on sugar regulation While the exact dignity and relationship of these centres are far from being solved, it seems that the blood sugar regulating centres constitute a very important mechanism, comparable to heat regulation

The head injury as inflicted in our animal experiments and as seen in clinical cases, may start a sympathetic discharge not only from the floor of the fourth ventricle but from the midbrain and interbrain The impulse can be blocked by the section of the splanchnic nerves An increased irritability can be demonstrated in the animal experiments up to the tenth day It manifests itself in a sudden rise of the sugar tolerance curve, which reaches a higher level than before the injury It is important to note, however, in Chart IV, that the blood sugar drops in one hour to the same level as before the injury The insulin response to the high sugar level is presumably intact, since the descending curve is not delayed

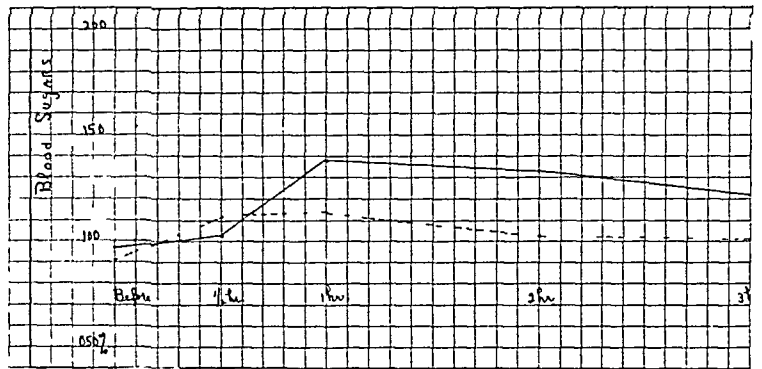


CHART VIII—Epinephrin curves of two patients several months following head injuries They had no residual symptoms Note the small rise but the delayed return to normal Straight line (—) Sam Br, aged forty three Basal skull fracture twenty five months previously Unconscious Made complete recovery Dotted line (.....) Charles F, aged thirty three Fracture of left temporal bone extending down to mastoid process Semi conscious Injury sixteen months previously Made complete recovery

Because of our findings in the animal experiments and also because of the difficulty or impossibility of running oral sugar tolerance curves on unconscious or semiconscious patients we selected the epinephrin test for testing an increased irritability of the sympathetic sugar regulation It is true that intravenous sugar tolerance determinations could have been made Such were used by Davidson and Allen in their studies of carbohydrates metabolism following head injuries However, such a sudden rise in blood sugar is not comparable with a slow absorption through the portal circulation and the curves cannot be interpreted as true tolerance curves

Our blood sugar determinations, taken at short intervals following the injury, *showed a rise in blood sugar in every instance* There is then quite a constant hyperglycemia following head injuries This fact can be easily overlooked if samples are not taken early enough as in Davidson's and Allen's series We were struck by the coincidence of loss of consciousness with hyperglycemia This factor and not the fracture or the increase in intracranial pressure seemed to be of most importance The same observation has been made recently by Bstek and Driak¹⁸ in Eiselberg's Clinic They think it quite probable that the midbrain and interbrain are involved in the loss of consciousness

The interpretation of the epinephrin curves is difficult. Individual differences are great and naturally no means of comparison are available from the same patient previous to the injury. However, a number of normal curves are known from work of Broesamlen¹⁰ Billigheimer,²⁰ Petenyi and Lax.²¹ The peak of the blood sugar curve is reached within an hour, it never exceeds 100 per cent of the initial value and is usually 50 to 60 per cent of the fasting blood sugar. The curve is back to normal in three hours.

The suggestion to test a residual cranial injury by the help of a persistent sympathetic irritability presupposes the possibility that a traumatic injury to the brain, such as minute hæmorrhage, blood clot or traumatic cyst, may be a constant source of irritation to the sympathetic centres and pathways. That a lesion of the basal ganglia may maintain a state of constant movements, as in paralysis agitans, is known and is suggested as an analogy. That this sugar mobilizing impulse is compensated in the normal individual, is reasonably to be expected, knowing the resources of the body to maintain normal blood sugar. However, when the epinephrin hyperglycemia fails to return to normal within three hours, an insufficiency of insulin output should be considered. In three of our cases such a delay was noted, one immediately and two several months following the injury. All three were above the age of forty. The importance of such findings even in a small series like ours must be emphasized. It is quite probable that a number of individuals about the age of forty have a diminished insulin reserve without, of course, being manifestly diabetic. The question arises, whether a prolonged sympathetic discharge, which occurs after head injuries, and calls for additional insulin output, may not result in a relative pancreatic insufficiency. In other words, can a head injury overtax an already impaired pancreas to an extent that a pancreatic insufficiency develops?

We do not believe that our few data solve this problem but we do offer a method of testing the sequelæ of head injuries, a method that presumably tells us how readily the pancreas can eliminate the excess of blood sugar, which resulted from the stimulation of the sympathetic fibres by the injection of epinephrin.

From a clinical standpoint every head injury sufficiently severe as to cause unconsciousness causes a temporary disturbance in sugar metabolism. If the patient has diabetes or an insufficient insulin response which predisposes him to diabetes this temporary upset in sugar metabolism may readily make worse or precipitate an actual diabetes. We believe to this extent the head injury may be looked upon as the exciting cause of the diabetes—the true cause being due to the usual pancreatic lesion. The bridge between a temporary traumatic hyperglycemia and true diabetes is a strong sympathetic discharge requiring adequate insulin response. If the latter is not available a breakdown of sugar regulation may ensue.

From our observations of a very large series of head injury cases, observed months to years following the injury, watched especially from the

standpoint of a true diabetes following the injury, we agree with other observers that the condition is extremely rare

The practical points which have been developed as a result of this study and which may have a clinical application are

1 The epinephrin injections, followed by glycemia determinations, can be used in cases of old head injuries, claiming or showing certain residual signs or symptoms, to determine if these are really due to continued or persistent cerebral irritation

Example—In four cases of old skull fractures, claiming dizziness, headaches, ringing in the ears and anxiety neuroses referred for examinations within the last three months this test was made, in three it showed a delay in return to normal in the hyperglycemia curve, but in the third there was no delay in return to normal. In this case we felt his condition was a pure hysteria—a compensation hysteria rather than a true persistent cerebral contusion. These four cases, combined with the eight shown in Chart VII, make twelve cases of old skull fractures studied. In six, all showing residual signs, the epinephrin curve test was positive. In one the negative epinephrin curve test helped in the differential diagnosis between a hysteria and true persistent cerebral irritation

2 We believe this test should be made upon every head injury case before he is discharged from treatment. If the test is normal at the end of treatment period, we do not believe that any subsequent diabetes which might develop could justly be attributed to the head injury. On the other hand, if a patient at time of discharge shows a disturbed carbohydrate metabolism by this test and then later should develop true diabetes the injury could rightly be held as an aggravation or as the exciting cause—the true cause, of course, being a pancreatic pathology

This test with the glycemia determinations therefore may prove to be a positive method of securing a real answer to this very old medicolegal problem

3 In a recent case of skull fracture the patient was progressing exceedingly well when suddenly she went into coma which rapidly became profound. There was a strong acetone odor to her breath and the coma resembled more a diabetic coma than one due to hæmorrhage with cerebral compression. There were no focal signs indicating cerebral involvement. A blood sugar determination was made which showed a very marked hyperglycemia. Inquiry then revealed the fact that she had been treated for diabetes some fourteen years previously. If a blood sugar determination had been made immediately this condition would have been discovered in time most probably to prevent coma and death

Therefore the most practical deduction from this study may be stated as follows

Every head injury severe enough to cause cerebral injury has within the first twenty-four hours an increase in blood sugar, if there is a diabetic tendency this upset in carbohydrate metabolism may become a serious menace, therefore, every such case should have a blood sugar determination

made within the first twenty-four hours From a medicolegal standpoint every patient who has suffered a head injury and particularly those with loss of consciousness should have a routine fasting blood sugar three or four times within the first year, together with an epinephrin curve a few weeks after the injury The epinephrin hyperglycemia simulates the traumatic one in many respects and appears to be a good check for testing for residual symptoms If the fasting sugar and the epinephrin curve, particularly its downward course, seem normal during the first year liability for a later developing diabetes cannot be acknowledged If the sugar values are persistently high and the epinephrin curves show a slow drop to normal, the patient must be regarded as a potential diabetic and if actual diabetes later develops the injury must be held as an exciting cause

CONCLUSIONS

1 Head injuries of sufficient severity to cause loss of consciousness result constantly in hyperglycemia which subsides within the first day or a few days This has been found in animal experiments and in a small number of clinical cases

2 Section of the splanchnic nerves in the dog abolished this hyperglycemia The sympathetic discharge originating in the higher centres of sugar regulation is unable to reach the liver and mobilize glycogen

3 This state of sympathicotonia manifesting itself in increased epinephrin susceptibility was tested in patients shortly after and many months following the head injury While the immediate response was stronger than in controls, the late curves were mostly negative with the exception of those who had marked residual damage

4 A few patients were found whose epinephrin curve was not abnormally high but showed a delay in returning to normal These patients were all above forty years and may have a mild pancreatic damage This is not uncommon at this age and deserves careful consideration

5 This small series cannot entitle us to make any further statements and only suggests a method of studying head injuries and their sequelæ Theoretically, however, the possibility of upsetting an already weakened pancreatic activity by a sudden sympathetic discharge followed by a marked rise in blood sugar, must be considered

We wish to acknowledge our sincere gratitude to Dr A L Ivy Professor of Physiology at Northwestern University, for his continuous advice and helpful suggestions during the work done in his department

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THE PART WHICH IODINE HAS PLAYED IN THE TREATMENT OF PATIENTS WITH EXOPHTHALMIC GOITRE*

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A SHORT review of the development of surgery for exophthalmic goitre is interesting. The mortality following the early operations performed for this disease was extremely high. This, no doubt, was due to the type of operation used and lack of knowledge of the clinical course of the disease. When it was recognized that patients with acute hyperthyroidism could be operated on only with great danger, and that many of these, following medical management, later improved sufficiently to allow operation to be more safely performed, the mortality following operation became lower. Recognition of this fact, no doubt, caused more intensive study of the clinical course of exophthalmic goitre and it was learned that the disease in most cases ran a rather typical course, during which there were periods of progression and regression of the acuteness of the symptoms.

Ligation of one or both of the superior poles of the thyroid gland was then introduced and this procedure was thought to cause more rapid regression of the symptoms of the disease. It soon was learned that even ligations could be performed safely only on patients in whom the disease had not progressed too close to a crisis and on those who were in a regressing period of the disease. At first, ligations were done in severe cases as measures preliminary to thyroidectomy, and in mild cases as curative measures. Later, ligations were often used to test the ability of a given patient to stand a more radical operation, such as thyroidectomy. Ligations played an important part in the development of surgery for exophthalmic goitre and through their use the mortality was considerably lowered. There is some question, however, as to the real manner in which ligations caused regression of the acute symptoms of the disease, and it is possible that the improvement which followed their use may have come from postponement of the thyroidectomy for several months, as was usual after ligations were performed.

The mortality after ligations were used was still sufficiently high to cause differences of opinion among physicians as to whether or not surgery was the best means of treating patients with exophthalmic goitre. In well-organized clinics, where large numbers of patients with exophthalmic goitre were being operated on the mortality was relatively low. However, following thyroidectomy done by operators, who were inexperienced in dealing with this disease and who rarely performed thyroidectomy, the mortality was high. Because of the mortality and poor end results following operation in certain cases, many patients dreaded the thought of operation and refused surgical procedures.

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Before the period when satisfactory metabolic tests were possible surgeons often failed to remove a sufficiently large amount of thyroid gland to eradicate completely the hyperthyroidism. The results following operation, therefore, were far less satisfactory than at present. After satisfactory methods for computing the basal metabolic rate were developed the end results, accordingly, were improved by forcing surgeons to remove a larger amount of thyroid tissue. On account of the mortality and the differences of opinion as to the best means of treating the diseases, roentgen-ray treatments which had been used to a certain extent for years again were revived and the treatments were given in much larger doses. These treatments were extensively used for a while, but have been largely discarded.

Iodine has long been used in various ways in treating exophthalmic goitre, but it usually was given with an idea of curing the disease instead of, as at present, preparing patients for operation. Some years ago, Marine stated that iodine tended to cause a regression of goitre of the hyperplastic type to goitre of the colloid type. The practical use of iodine as a means of preparing patients with exophthalmic goitre was not standardized to such a degree that it was of any particular surgical value and its use in the treatment of exophthalmic goitre had been largely dropped when it was revived by H. S. Plummer, in March, 1922. Plummer noted marked improvement following its administration in doses sufficiently large to supply the thyroid gland with enough iodine to permit it to produce normal thyroxine, and he quickly recognized its value as a means of preparing patients for operation and of controlling serious post-operative reactions. Plummer based the improvement which followed the use of iodine on the hypothesis that the thyroid gland in exophthalmic goitre was unable to deliver a normal product when the iodine supply was relatively low. In the early cases treated with iodine in The Mayo Clinic, it could scarcely be believed that hyperthyroidism in patients who presented themselves for operation during the acute stages of the disease could be controlled following a quickly performed thyroidectomy, therefore, the use of ligations was continued. Soon, however, it was found that primary thyroidectomy could be safely performed on many patients who had been prepared with iodine, and, from year to year since, the number of ligations performed has rapidly decreased. At the present time the operation of ligation is recognized by many as being practically an unnecessary measure in the treatment of exophthalmic goitre.

Since the standardization of metabolic tests and of the preparation with iodine of patients for operations rapid advances have been made in the management of patients with exophthalmic goitre. When considered alone, the basal metabolic rate has been of no particular value as a means of determining when operation should be performed, it is regarded merely as an index to the degree of hyperthyroidism present when it is taken. The reaction of a patient with exophthalmic goitre after treatment with iodine really has proved of greater value in the treatment of the patient than a knowledge of changes in the basal rate. The knowledge of basal rate has been of value in aiding in the diagnosis of exophthalmic goitre in certain early and atypical cases and

has been a helpful means of noting improvement. It, also, has been a very valuable method of determining, after operation, whether hyperthyroidism still exists and whether hypothyroidism is present.

Through the use of iodine it has been possible rapidly to prepare patients for thyroidectomy and to control serious post-operative reactions. Mortality has been greatly reduced, and since it is possible to perform thyroidectomy earlier, the long duration of hyperthyroidism, which was so harmful to patients treated by the older methods, has been greatly diminished. In this way the morbidity and the expense to patients have been greatly reduced. Better end results are obtained because thyroidectomy is performed in many cases before exophthalmos or serious organic changes have occurred. The poorest end results following operation at present occur in patients operated on after a long-continued period of hyperthyroidism and who at the time of operation show evidences of marked organic disease. Before patients were prepared for operation by the use of iodine, it was possible in only about 30 per cent of the patients to perform safely a primary thyroidectomy, and it was necessary, in about 70 per cent, to use preliminary operations, such as hot water injections or ligations. Often, long-continued pre-operative medical treatment was necessary before these preliminary measures could be safely done.

In 1927, 1520 patients were operated on in The Mayo Clinic for exophthalmic goitre. Ligations were done in only nine of these cases. Ligations have not been performed so far (December 11) during the year 1928. Patients with large goitres of long standing, who respond poorly to iodine treatment and who, as a rule, have lost much weight and strength, are still seen. On these, one still may feel inclined to perform ligations in order that the patients may be given time to gain weight and strength. Except in this group of patients, however, ligations are seldom indicated. At the present time, the mortality following operations on patients who come for operation during the first six months or even during the first year after the onset of the disease, and who have been properly prepared with iodine, probably is no greater than that which would follow thyroidectomy on a normal individual.

The use of iodine in preparing patients with exophthalmic goitre for operation may be looked on as having brought about the following changes:

1. *Reduction of Mortality*—Marked reduction in mortality has followed the use of iodine in preparing patients for operation. In 1520 patients operated on in The Mayo Clinic in 1927 for exophthalmic goitre, there were eleven deaths, a mortality of 0.72 per cent. In this group were included early, late and recurrent cases. In cases in which operation was performed within the first six months or even during the first year following the onset of the disease, the mortality was practically nil. A death in such cases usually is an accidental one, due to secondary hæmorrhage, injury to a nerve or to the development of an acute pulmonary infection following operation. Only a few years ago it was not uncommon for death to occur in certain cases during the very acute stages of the disease before operation. At present death

in such cases rarely occurs as it is possible, through the use of iodine, to control rapidly serious hyperthyroidism in practically all cases

2 *Reduction of Morbidity*—Patients are subjected to thyroidectomy much earlier than formerly and during a period of the disease before marked organic changes have occurred. The end results, therefore, following the early performance of thyroidectomy have been far better

3 *Saving of Time to Patients*—Since iodine has been used to prepare patients for operation, much time has been saved for them. It usually is possible in early cases of goitre to prepare patients for thyroidectomy within eight days to two weeks after the use of iodine has been started. Furthermore, it is possible now for most patients who come early for operation to return much sooner to their former work. The elimination of preliminary operations in practically all cases also has greatly diminished the delay formerly necessary before thyroidectomy could be performed safely

4 *Reduction of Expense to Patients*—Because of the short time necessary to prepare patients for operation and the ability to perform primary thyroidectomy on patients who come early for operation, the hospital expense to patients has been greatly reduced. The majority of patients may be prepared while living in their homes, in boarding-houses or in hotels and may be sent to the hospital for operation after the preparation has been completed. In this way many patients remain in the hospital only five or six days. The ability to have a thyroidectomy quickly performed and to return early to work has meant a tremendous saving in expense to patients with this disease

5 *Diminution of Recurrences*—Early operation, the use of iodine following operation and the removal of a larger amount of glandular tissue have diminished materially the percentage of recurrences. When there is recurrence it often may be controlled by further use of iodine. Should this fail, however, to control the hyperthyroidism after a reasonable time, the assumption usually is either that too much thyroid tissue was left at operation or that the thyroid tissue left has undergone hypertrophy. In such cases, a portion of the thyroid tissue present is removed in order to reduce the basal metabolic rate to normal and thus to prevent the slow organic changes which will develop following long-continued, low-grade hyperthyroidism

6 *Diminution of Difficulties of Operation*—Thyroidectomy, as a rule, may be performed more easily on patients operated on early in the course of the disease than on those operated on following long-continued hyperthyroidism and who present themselves with large, hard, vascular, friable glands. The operations in the early cases are easier because of a greater amount of colloid material in the gland. The possibility of post-operative complications, such as secondary hæmorrhage and injury to a nerve, also is lessened in cases in which operation is performed early

COMMENT

On account of the great number of patients directly affected by treatment with iodine in preparing them for operation for exophthalmic goitre, I believe it may be looked on as being the most important advance that has been made in any branch of surgery since its introduction in 1922

TREATMENT OF ABDOMINAL INJURIES IN CHILDREN *

WITH THE REPORT OF FIFTY-NINE CASES

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WITH the increased use of the automobile and the consequent greater number of street accidents, injuries to children have become more numerous. This is particularly evident in the general hospitals in large centres of population. Among the many types of injuries observed, there are none of more interest to the surgeon than those with the signs of damage to intra-abdominal organs. In these the patients are often admitted to the ward in a state of profound shock, with shallow respiration, rapid thread-like pulse, and rigid retracted abdominal muscles. A condition of affairs in which it is evident that an immediate decision must be made, as operative interference is required to save life in some types of abdominal injury and is unnecessary in others, an error at this time may result in the loss of the patient's life.

Some years ago, a child, nine years of age, was seen who, shortly before admission, was run over by an automobile, one of the wheels was said to have passed over the upper abdomen. The boy was in a state of profound shock, pale, with frequent shallow respiratory movements and a rapid thread-like pulse. The abdomen was retracted, the muscles stiff and board-like and there was marked tenderness over its upper half. An exploratory laparotomy was performed, the peritoneal cavity was found to contain a slight amount of blood-stained serum, but no intra-abdominal injury was discovered. The following day the patient coughed up a small blood clot and later a right pneumothorax was discovered. The boy recovered, but how much better for him if he had not been operated upon.

A boy, ten years of age, was admitted to the Surgical Ward of the Lincoln Hospital, having been run over by an automobile. The patient was in a state of severe shock, his abdominal wall was retracted, rigid and tender over the entire surface. The respiratory movements were altogether thoracic in character. There were no signs of fluid or gas within the abdomen and the urine contained no blood. There followed a period of reaction in which there was an improvement in the color of his skin and character of his pulse, however, this did not last long, for at the end of twenty-four hours signs of peritoneal irritation appeared. He became restless, vomited, and his abdomen was distended and tender. These symptoms were progressive in intensity until the boy died at the end of three days. Fortunately, an autopsy was obtained. The examination disclosed a large hæmatoma infiltrating the retroperitoneal space. The source of the hæmorrhage could not be found as there was no injury to any of the intra-abdominal organs. Before the findings of the post-mortem examination were known, it was thought that a grave error in judgment had been made. However, later it was evident that operative intervention would have been useless for there was nothing that could have been gained by it.

Recently a series of fifty-nine case histories of patients who showed signs of intra-abdominal injury were collected from the Children's Surgical Service, Bellevue Hospital. This series contains thirty-two cases in which the diagnosis was confirmed by operation or autopsy, fourteen in which the

* Read before the Surgical Corps of the Lehigh Valley Railroad

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clinical symptoms were thought to be of sufficient evidence to place the injury, and thirteen in which a precise diagnosis could not be reached. It is to be regretted that the records of more patients who recovered, in which the diagnosis was uncertain, were lost through being filed under the large group of "Diagnosis Unknown", consequently, the mortality rate of the series is not obtainable. Thus there were forty-six cases in which the diagnosis was reasonably certain, and thirteen in which the injury could not be localized.

TABLE I
Cases Reported

			No. of cases
Injuries to chest			8
Injuries to chest and abdomen	{ Lung and liver	3	
	{ Lung, liver and spleen	1	4
Injuries to intraperitoneal organs	{ Spleen	2	
	{ Liver	7	
	{ Liver and spleen	3	
	{ Liver and kidney	1	13
Injuries to intestinal tract			3
Injuries to large vessels			2
Retroperitoneal hæmorrhage	Pelvis fractured	3	10
Intra-abdominal injuries, organs unknown			13
Injuries to kidney			6
Total			59

In those patients with injuries to abdominal organs that died, death occurred on the average of within two and a half hours following the accident, while those with injury to the lungs alone lived for at least five hours. The accompanying tables show the types of injuries in detail.

The injuries were severe in the thirty-one patients that died, four were operated upon, in nineteen the diagnosis was established by post-mortem examination, in two the injury, fractured pelvis, was discovered by the physical examination, and in three cases the exact diagnosis was not known, as the patients died within an hour following the accident. In the case of the six patients with ruptured lungs, the eight with injury to more than one organ, the two with laceration of large vessels, and the two with pelvis fractures there were no evident indications for operation, this leaves those with injuries to the spleen and liver for discussion.

The patient with rupture of the spleen would have been operated upon if he had been seen early enough, but since he lived but three hours, there is doubt whether he would have recovered.

In the six cases of rupture of the liver, the question may be asked, "Should these patients have been operated upon?" Four of them died within two hours following their injury and two within three hours. It is, therefore, hardly conceivable that any of their lives could have been saved by operation and it is probable that the added shock would have hastened death.

There were twenty-eight patients that recovered. Of these children, six were operated upon, one for ruptured spleen, one for laceration of the small

intestine and four who had retroperitoneal hæmorrhage of unknown origin. The ten patients with unknown internal injuries were possibly cases of ruptured liver or retroperitoneal hæmorrhage.

TABLE II

<i>Known Injuries to Organs in Chest with Abdominal Signs</i>			
Number of cases	Diagnosis	Evidence	Results
1	Ruptured lung	Autopsy	Died 24 hours
2	Ruptured lung	{ 1 Operation 1 Autopsy }	Died 7 hours
1	Ruptured lung		
2	Ruptured lung	Autopsy	Died 6 hours
		Autopsy	Died 2 hours
<i>Chest and Abdominal Organs</i>			
1	Ruptured lung and liver	Autopsy	Died 45 minutes
1	Ruptured lung, liver and spleen	Autopsy	Died 45 minutes
1	Ruptured lung and liver	Autopsy	Died 6 hours
1	Ruptured lung and liver	Autopsy	Died 2 hours
10	Average life of deaths from ruptured lungs		
	Average life of deaths from ruptured lungs complicated by abdominal injuries		
	8 hours		
	2½ hours		

To summarize in the whole series of fifty-nine cases there were ten operations, in four of them the indications were definite one for ruptured spleen and three for laceration of the intestinal tract, in two of these the patients' lives were saved. In the remaining six cases the operations were merely exploratory in character. One of these patients had a ruptured lung and died, another had an injured kidney with a large retroperitoneal hæmorrhage, he also died. The four remaining children had retroperitoneal hæmorrhage of unknown origin, they all recovered in spite of the added shock from the operation. Of the ten operative cases in only four was the procedure warranted.

It is apparent, from the study of these cases, that it is not essential to submit all children with signs of abdominal injury to operation. In a small proportion of the cases (less than 7 per cent) operative intervention is necessary to save life, in a larger group it is not required and will in many cases precipitate death by the added shock or hæmorrhage. It is evident that to carry out the proper treatment in an individual case the surgeon must know the condition he is dealing with. To determine this is difficult as in many injuries of the abdominal and thoracic organs the only symptoms are those of peritoneal irritation. For this reason, I believe, it has become a habit for some surgeons to explore every patient with signs of intra-abdominal injury, in the hope that he may find one of the conditions which can be benefited by operation. This would appear to be rather a small chance.

Injuries to the lungs frequently produce abdominal signs and children with this condition have been operated upon under the impression that the lesion was intra-abdominal. The local signs in the chest are often masked by the

more apparent abdominal symptoms. A ruptured lung in a child is the result of a severe trauma, in which the thorax has been suddenly compressed, as in the case where a wheel has passed over the chest. Many times a tear in the lung is present without a fracture of the ribs, this accounts for the infrequency of subcutaneous emphysema in these patients. The explanation of the injury to the lung without accompanying fracture of the ribs, is the relative elasticity of the thoracic cage of the child.

In addition to the general and abdominal symptoms, the local signs in the chest are those of a pneumothorax. The diagnosis can be confirmed by the use of the fluoroscope or a roentgenogram. The pneumothorax often remains for some period of time, in one patient it persisted for six weeks. This is due to the fact that a collapsed lung with a rent in it may act as a flap valve allowing air to enter the pleural cavity, but preventing its exit. This forced collapse of the lung by the increased intrapleural pressure often prevents a hemothorax. It is evident that there are no indications for operation in cases of ruptured lungs.

The liver, spleen or kidneys may be injured by comparatively slight trauma, a small blow to the body. Where more than one organ is injured there is usually greater violence. These organs because of their structure burst asunder when compressed, producing large ragged wounds.

The liver, because of its size and the poor protection afforded it by the ribs, is often injured. The wound in its substance may be a single fissure or an extensive stellate tear. The surfaces bleed freely and these injuries are consequently accompanied by severe shock. The abdominal signs may at first be localized to the upper right quadrant of the abdomen, but soon become general and death may rapidly follow, therefore, the diagnosis of ruptured liver is difficult. There is a difference of opinion among surgeons, as to the advisability of operating in cases of ruptured liver. However, I believe that more lives can be saved by the non-operative treatment. It is my experience that there are two types of cases: those in which it is found at operation that the hæmorrhage has stopped, and those where the tear is so extensive that it is impossible to produce hemastasis by either suture or packing. The manipulation at operation often renews the bleeding in the former type of case.

The spleen, because of its small size and position under the ribs, is seldom injured alone, but injuries to it occur more often accompanying those of the liver or kidney. Where the child is seen early the abdominal signs are found to be well localized to the left upper quadrant, occasionally, there may be a complaint of pain in the left shoulder. Operation is indicated in the case of a ruptured spleen, as complete hemastasis can be obtained by the ligation of its pedicle.

Tears of the intestinal tract seldom occur, when they do the shock is severe, the abdominal signs are at first of local peritoneal irritation followed by diffuse peritonitis. The presence of gas within the peritoneal cavity may be discovered by the absence of the liver dulness, but this is not always present, or it may be found by the X-ray. Operative treatment is imperative.

FENWICK BEEKMAN

TABLE III

Known Injuries to Organs in Abdomen

Number of cases	Diagnosis	Evidence	Results
1	Ruptured spleen	Autopsy	Died 3 hours
1	Ruptured spleen	Operation	Recovered
2	Ruptured liver	Autopsy	Died 3 hours
3	Ruptured liver	Autopsy	Died 2 hours
1	Ruptured liver		
	Fractured ribs	Autopsy	Died 2 hours
2	Ruptured liver		
	Spleen		
	Fractured ribs	Autopsy	Died 2 hours
1	Ruptured liver		
	Spleen	Autopsy	Died 3 hours
1	Ruptured liver		
	Kidney	Autopsy	Died 2 hours
<hr/>			
12	Average life of the eleven deaths		2½ hours
1	Ruptured kidney (compound fracture of humerus)	Operation	Died 12 hours
<hr/>			
13			

The indiscriminate operative treatment of patients showing signs of injury to the kidney has resulted in the needless removal of many renal organs. Only those cases with definite indications should be operated upon. Continuous bleeding or extravasation of urine are the most common conditions calling for exploration. Hæmorrhage, unless it be from a torn hilum, will usually cease spontaneously, however, if the pedicle is torn there is little chance of saving the individual's life.

TABLE IV

Known Injuries with Marked Abdominal Signs

Number of cases	Diagnosis	Evidence	Results
1	Ruptured ileum	Operation	Recovered
1	Ruptured ileum	Operation	Died 30 hours
1	Ruptured stomach	Operation	Died 6 hours
<hr/>			
3			
1	Lacerations of mesentery	Autopsy	Died 2 hours
1	Laceration of vena cava	Autopsy	Died 2 hours
<hr/>			
2			
2	Retroperitoneal hæmorrhage	Operation	Recovered
1	Retroperitoneal hæmorrhage (later abscess)	Operation	Recovered
1	Retroperitoneal hæmorrhage	Operation	Recovered
<hr/>			
4			

TREATMENT OF ABDOMINAL INJURIES IN CHILDREN

In a series of nine cases of injury to the kidney, in children treated at the Lincoln Hospital, there was but one death. This was one of the three patients operated upon. The hilum of the kidney was badly torn and there was multiple fractures of the ribs. In the second operative case it was found that the kidney was not badly damaged. The third patient that came to operation had a definite indication for exploration. The boy was struck by an automobile, he was admitted to the hospital in a state of severe shock. There were signs of abdominal injury, a specimen of urine contained a few red blood cells, thereafter, the urine was blood free. In twelve hours the boy had recovered from shock, there was a rise in temperature at the end of twenty-four hours, at this time there were signs of dulness in the right flank. In forty-eight hours this dulness extended forward to the umbilicus, the patient was toxic. An extravasation of urine in the perineal space was found at operation. The kidney was completely divided, the vessels of the hilum being attached to the larger upper fragment and the ureter to the lower. This explained the fact that blood was only found in the first specimen.

TABLE V
Injuries to Chest and Abdomen
Clinical Diagnosis

Number of cases	Diagnosis	Results
1	Lacerated lung	Recovered
1	Hæmorrhage into mediastinum	Recovered
1	Fracture of pelvis—retroperitoneal hæmatoma	Died 24 hours
1	Fracture of pelvis—retroperitoneal hæmatoma	Recovered
3	Retroperitoneal hæmorrhage	Recovered
3	Internal injuries—organs unknown	Died 1 hour
10	Internal injuries—organs unknown	Recovered
1	Internal injury—(liver)	Recovered
5	Ruptured kidney	Recovered
<hr/> 27		

A comparatively large number of injuries in children, causing abdominal symptoms are conditions producing a hæmatoma in the retroperitoneal space. Hæmorrhage into this space may be due to injury of the kidney or to a fracture of the pelvis, but there are other cases in which there is a diffuse hæmatoma, where no large vessels have been divided, the hæmorrhage apparently coming from small ones. The symptoms and course of this condition are definite, the children are admitted in a state of extreme shock with rapid, shallow respirations and retracted abdominal walls. The abdominal muscles are rigid and the tenderness is diffuse from the start. Reaction usually occurs in six to twelve hours, though the abdomen may remain rigid for two to three days, this is followed by a distention of the intestines which occasionally lasts as long as a week. A slight rise in body temperature accompanies these symptoms.

SUMMARY

1 Symptoms of abdominal injury are found in children with damage to thoracic as well as to abdominal organs

2 Injuries to the liver or those to more than one organ are accountable for the majority of deaths, which may follow the injury within a few hours

3 Injuries to the spleen and intestines are relatively rare in children

4 Retroperitoneal hæmorrhage is comparatively common following trauma to the abdomen of children

5 Injuries to the kidney may follow slight trauma Operative treatment is only advisable where there is a definite indication

6 With the exception of a rupture of the spleen or the intestine, immediate operative interference is unnecessary

7 It is believed that the lives of more children with injuries to the liver can be saved by palliative rather than by operative treatment

8 For the proper treatment of abdominal and thoracic injuries an early diagnosis may be arrived at Diagnosis by operative exploration is not justifiable as the lives of many children will be further jeopardized Intelligent conservatism in the treatment of intra-abdominal injuries of childhood will save the greatest number of lives

A TREATMENT OF PERSISTENT BRONCHIAL FISTULA

AN EXPERIMENTAL AND CLINICAL STUDY

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CELSUS⁸ is quoted as saying, "Fistulas of the chest are very difficult of treatment, so that sometimes physician, sometimes patient, giving up hope, leaves the case to Nature herself." Some of the instruments used by Hippocrates and Paulus Aeginata are described in the writings of Fabricius ab Aquapendente.¹² He stated that most persons who had received a penetrating wound of the chest had to wear a silver tube for life, and that he knew of patients who had carried tubes for twenty to thirty years. In discussing the treatment, he says the hard skin of the fistula should be removed either by softening or by instruments. Furthermore, "all corruption must be removed and the fistulous tract straightened by cutting the curves with a knife."



FIG. 1.—Case I. Abscess in right upper lobe showing the fluid level in the erect position.

From these early times, the subject of bronchial fistula has received oc-

casional attention, not, however, until recent years has the subject been given scientific consideration and operative treatment been systematically attempted.

A bronchial fistula is a communicating tract between a bronchus and the pleural surface of the lung or cutaneous surface of the thoracic wall. There are, therefore, two types: broncho-pleural and broncho-cutaneous. On the basis of etiology, Eggers¹¹ makes the following classification: (a) those due to intrapulmonary suppuration, (b) those due to external violence which has produced a perforating wound of the chest wall.

It is probable that bronchial fistulas are most commonly encountered in empyema thoracis as a cause or complication of this condition. The major-

ity are small and heal spontaneously. However, in certain cases, a fistula may persist, and be the chief factor of the chronicity of an empyema cavity. A fistula may result from a lung abscess, either spontaneously if the abscess ruptures into the pleural cavity, or following the operative treatment of the abscess. In the same way, suppurative bronchiectasis may be the cause. A fistula not infrequently occurs in pulmonary tuberculosis as a result of tuberculosis cavitation. Other pathological conditions that may be directly or indirectly the cause of bronchial fistulas are lung abscess caused by the aspiration of a foreign body, actinomycosis, gangrene of the lung, or pulmonary suppuration due to an extension from a neighboring organ.



FIG. 2.—Case I. Lateral recumbent X-ray showing the fluid level.

When a fistula has developed, a number of factors may contribute to cause its persistence. Probably the most important is suppuration in the parenchyma of the lung or in the bronchial tree. Wilensky assumes that in a small number of cases the constant presence of low-grade infection in the bronchial tree, with the superposition of repeated attacks of acute inflammation, furnishes an important cause for the constant reinfection of the fistulous tract and failure to heal. An aspirated foreign body or a retained drain may be responsible for the persistence of the fistula. Finally, less apparent factors may be operative, thus a large bronchial fistula which opens into a rigid-walled empyema cavity is peculiarly liable to persist.

The walls of the fistula itself may become sclerosed. The entire tract may become epithelialized and may eventually produce a bronchocutaneous channel.

To the use of Dakin's solution has been attributed the development of some fistulas (Heuer,²³ Stevens⁴⁰). This is said to be especially likely in empyemas due to streptococcus infection in which the surface of the lung is

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studded with miliary abscesses Multiple bronchial fistulas occasionally occur, most often in bronchiectasis

The diagnosis of bronchial fistula is, as a rule, self-evident The sudden development of a profuse secretion from an empyema wound together with an increase in the severity of the cough should make one suspicious of the presence of a fistula If such an opening exists, the irrigation of an empyema cavity with Dakin's solution causes a paroxysm of coughing and the tasting of the solution by the patient In a larger fistula, the diagnosis is self-evident when air is heard to escape from the wound This sound is continuous when the patient strains with the glottis closed In doubtful cases, the diagnosis may be confirmed by X-rays following the injection of lipiodol into the thoracic wound



FIG 3—Case I X ray taken ten days following drainage of abscess

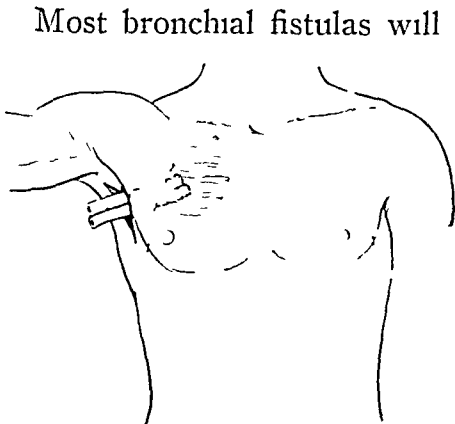


FIG 4—Diagrammatic sketch of location of abscess and drainage tubes in place (From ANNALS OF SURGERY, March 1927)

Most bronchial fistulas will eventually close spontaneously if the underlying lung infection is cleared up Neuhof³⁵ feels that this is practically always true But, it must be emphasized that in many of the cases the processes of repair and closure occur only after a long period of time Occasionally, a fistula persists indefinitely in spite of the subsidence of the underlying lung infection, especially where a large bronchial fistula opens into a chronic empyema cavity, or where a broncho-cutaneous fistula has formed It

is for such cases, particularly, that the operation to be described is suggested

It is important before attempting to close a fistula to verify the presence or absence of an underlying lung infection or a bronchiectasis by the history of the case, the clinical course, and by lipiodol injections The pres-

ence or absence of a foreign body must be determined before instituting any treatment. Bronchoscopic removal of an aspirated foreign body or the removal

of a lost drain by thoracotomy will very often result in rapid closure of the fistula.

Treatment—The question of closing a bronchial fistula should only be considered after the need of drainage has passed, in other words, when the parenchyma of the lung is no longer acutely inflamed and in the absence of a bronchiectatic cavity. An empyema must be considered and treated as such independently of the fistula. If a bronchial fistula is closed in the presence of an active inflammatory process, an extensive acute pulmonary infection, or even embolic abscesses, for instance, in the brain, may occur.

FIG 5—Case I. X ray following injection of lipiodol into axillary sinus showing the presence of a bronchial communication.

Numerous methods have been recommended for the closure of bronchial fistulas. The simplest consists in the cauterization of the fistulous opening.

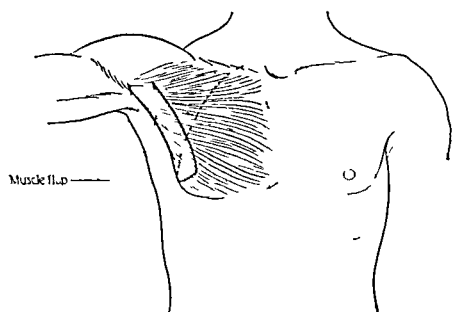


FIG 6—Case I. Diagrammatic sketch indicating outline taken from the (From ANNALS OF SURGERY, March, 1927.)

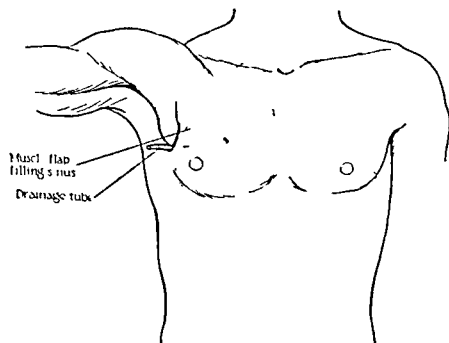


FIG 7—Case I. Diagrammatic sketch showing the insertion of the pedicled muscle flap into the cavity with a drainage tube placed beneath it. (From ANNALS OF SURGERY, March, 1927.)

The substances recommended have been numerous, the method usually consisting in local applications of the chemical or actual cauterizing agent to

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the fistulous opening, the object of the treatment being to destroy the bronchial epithelium and to produce the formation of granulation tissue. In very small fistulas, this method is often successful. Keller²⁶ has obtained many closures with the use of gentian violet.

Other methods are based on the fact that many fistulas found in chronic empyema close spontaneously after mobilization of the lung or collapsing operations on the thoracic wall. This is undoubtedly true if the fistulas are small. With larger ones, however, spontaneous closure does not always occur. A



FIG. 8—Case II. Anteroposterior X-ray following lipiodol injection showing the extent of the empyema cavity.



FIG. 9—Case II. Anteroposterior X-ray following lipiodol injection with the cavity half filled, showing a prolongation of the cavity mesially.

striking example of this point is the second case reported in this paper. To close such fistulas, other methods have been employed, as purse-string sutures, or pedicled muscle or skin flaps placed *over the mouth* of the fistula. The insertion of purse-string sutures for the closure of bronchial fistulas is not a promising procedure, because the sutures are introduced in diseased tissue and tied under tension.

Abrashanoff¹ in 1911 reported the use of a pedicled muscle flap placed *over the mouth* of



FIG 10—Case II Indicates the appearance of the wound following one of the stages of a graded thoracoplasty (From *American Journal of Surgery* October, 1927)

pulse-string suture, a free graft of fascia and fat, and a pedunculated flap of skin and muscle. Others have recommended such radical procedures as cauterization, pneumonectomy, and lobectomy, the real indication, however, for such procedures being the underlying diseased lung. A few writers have reported good results by the use of radium and Beck's paste.

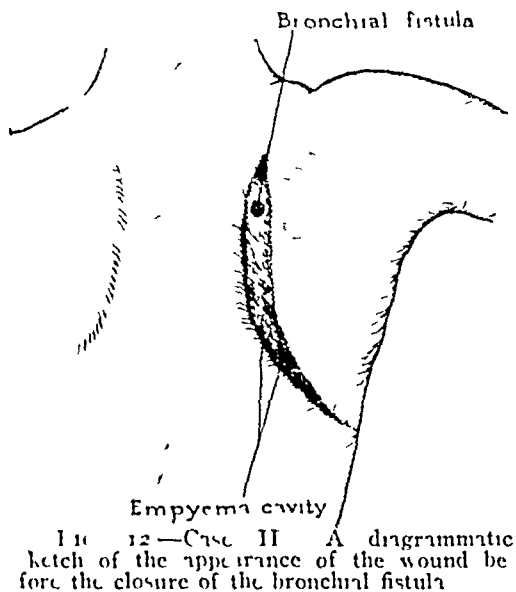
We offer another method for the treatment of bronchial fistula. Its merits are its simplicity, its wide application, and its uniform success in our hands. As has been emphasized any underlying parenchymal or bronchial infection or a

a bronchial fistula. Since that time, many surgeons have made use of this principle. The results have been fairly satisfactory. These operations have usually been performed in conjunction with decortication of the lung or collapse of the chest wall. Others have employed pedicled skin flaps in the same manner. Halstead and Thurston¹⁸ reported the use of a combination of



FIG 11—Case II Shows the appearance of the wound before closure of the bronchial fistula. At the upper angle one may see a dark area which indicates the position of the bronchial fistula (From *American Journal of Surgery* October 1927)

coexisting empyema must be treated before operation for the closure of the fistula is attempted. The operation itself consists in the exposure of the fistula through an adequate incision without disturbing the relation of the lung to the chest wall, the fashioning of a pedicled muscle flap from neighboring muscle tissue, the insertion of the end of this flap into the bronchus as one inserts a cork into the neck of a bottle, the suture of the sides of the muscle flap to the tissues in the immediate neighborhood to prevent dislodgment, and finally, closure of the operative wound. This pro-



cedure has been carried out in three cases, which illustrate different types in which the method may be employed, we report their histories in detail.

REPORT OF CASES

CASE I*—P. S., male, twenty-six years of age, was first admitted to the Medical Ward of the New York Hospital in August, 1911, with a diagnosis of incipient tuberculosis. He had physical signs at the right apex, but repeated sputum examinations were negative. Following tonsillectomy soon afterward all his symptoms cleared up.

He was readmitted January 19, 1926, with the signs and symptoms of a large lung abscess of about three weeks' duration. The amount of sputum expectorated during twenty-four hours

FIG. 13—Case II. An outer skin flap has been dissected from the underlying musculature and a pedicled muscle flap has been fashioned.

averaged eight ounces. The abscess was situated in the right upper lobe (Figs. 1 and 2). Repeated examinations of the sputum failed to reveal tubercle bacilli, but showed short-chain streptococci. White blood cells, 14,250, polymorphonuclear leucocytes, 68 per cent. The abscess was drained February 4, 1926. Under local anesthesia, an incision was made in the right axilla. About two inches of the fourth and fifth ribs were removed. The abscess was found about one quarter of an inch from the periphery of the lung. Considerable fetid pus was evacuated. Two large rubber tubes were inserted for drainage (Figs. 3 and 4). A specimen of the lung excised at the time of this operation revealed, upon microscopic examination, a mass resembling mycelia with clear spore-like bodies. Occasional branched forms were seen. These masses resembled some

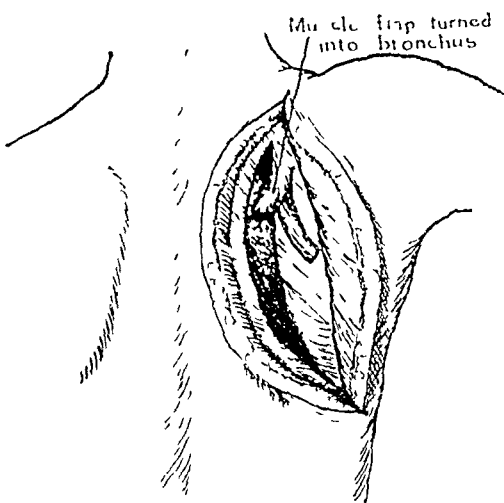


FIG. 14—Case II. Diagrammatic sketch showing the muscle flap turned into the bronchial fistula as one would place a cork into the neck of a bottle.

* Reported in *ANNALS OF SURGERY*, March, 1927.

form of higher bacteria, possibly *Aspergillus nodularis*. Autopsy of a guinea pig injected with two cubic centimetres of the pus showed no lesions.

The convalescence was uneventful. Repeated sputum examinations were negative for tuberculosis.

The man was readmitted April 26, 1926, with a persistent sinus which communicated with a bronchus. X-ray examination after lipiodol injection into the sinus showed a bronchial fistula (Fig 5).

On May 3, 1926, an operation for closure of the fistula was performed. The skin around the sinus was excised and newly-formed bone encircling the opening into the thorax removed. The cavity

was about the length of the index finger. Its walls were soft and somewhat friable, and the cavity measured about two centimetres in diameter. The incision was extended along the lower margin of the pectoralis major muscle. A strip of muscle about twice as thick as the cavity, and four and a half inches in length, was dissected free, leaving its upper end attached (Fig 6). This pedunculated flap was then turned into the cavity (Fig 7) and fixed by two chromic sutures at the outlet. A small rubber tube was placed along the flap to the bottom of the cavity to prevent retention. The wound was sutured except at its central portion, which was packed with gauze. Ethylene anaesthesia, time, twenty-eight minutes. There was no cough after operation, and the wound healed rapidly. The tube was gradually shortened, and was removed on the fifth post-operative day.

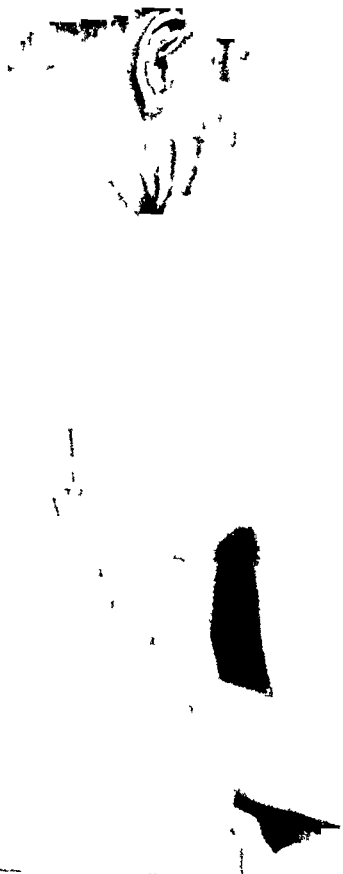


FIG 15—Case II. Photograph taken fourteen days following closure of the empyema wound. (From *American Journal of Surgery*, October 1927.)

When last seen, March 31, 1929, the patient stated he had gained thirty-five pounds and had no complaints. He is working regularly. X-ray examination shows no abnormality of the lung.

CASE II†—E. K., male, twenty-four years of age, was first admitted to the Medical Ward of the New York Hospital, May 3, 1925, with a right lower lobar pneumonia. This was followed by an empyema which, upon aspiration, cultured streptococcus hemolyticus. The patient was transferred to the Second Surgical Division, and May 16, 1925, a rib resection was performed under local anaesthesia. Two rubber tube drains were inserted and the cavity was later dakinized. Convalescence was uneventful, and the patient was discharged July 1, 1925, to the country, with a small wound draining a small amount of fluid.

† Reported in *American Journal of Surgery*, October, 1927.

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He was readmitted July 13 1925 with the history that he had begun to have fever and increased discharge from the sinus. There was no evidence of encapsulated fluid. On two occasions the sinus was enlarged. It was evident that there was a large chronic empyema cavity. As the patient was in rather poor condition two transfusions were given. He was discharged October 4 1925 to the country with the recommendation that after his general condition had improved he was to return for obliteration of the cavity.

He was readmitted May 6 1926. The cavity had a capacity of sixteen ounces (Figs 8 and 9). X-ray after lipiodol injection showed an extensive empyema cavity. Because his general condition was only fair it was decided



FIG. 16—Case II. X-ray following closure of the empyema wound showing the layer of air between the visceral pleura and the overlying chest wall.

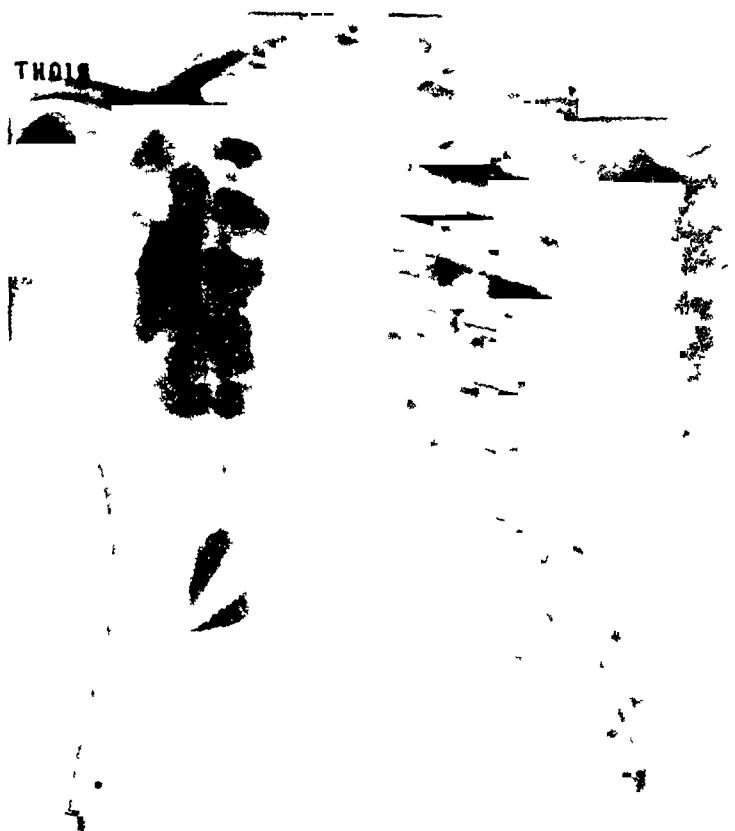


FIG. 17—Case II. X-ray three months later indicating the absorption of the air noted in Fig. 16.

to employ a graded thoracoplasty after the method of Keller. The stages of this procedure were performed May 11, May 22, June 8, and June 24, 1926, and entailed the removal of sections of the tenth, ninth, eighth, seventh, sixth, fifth, fourth, and third ribs (Figs 10 and 11). Between the various stages, the Carré-Dakin treatment of the wound was used. Following the last operation, there was seen at the upper end of the cavity a large broncho-pleural fistula, measuring two centimetres in diameter. During the subsequent ten days, the entire cavity was packed with gauze saturated with 25 per cent alcoholic solution of gentian violet. The wound was then dakinized and, on successive dressings, it was seen that the superficial lay-



FIG 18—Case III—Indicating the appearance of the wound before operation for the closure of the fistula

tured to the rim of the opening with interrupted chromic catgut stitches. The visceral pleura was then subjected to discission after the method of Ransohoff. The wound was packed. Ethylene anæsthesia, time, twenty minutes. There was no coughing during convalescence. The fistula remained closed, the muscle uniting by primary union. Following the decortication, considerable expansion of the lung was noted.

The cavity was then dakinized and after obtaining six successive negative cultures, was closed on September 1, 1926. At this operation, the two skin flaps were well mobilized, the various muscle flaps were freed and sutured together across the cavity, followed by closure of the skin. Two long rubber tube drains were placed between the muscle planes

of the thickened visceral pleura peeled off readily. However, extensive dakinization failed to sterilize the cavity and it was felt that the presence of this large bronchial fistula was the cause of failure.

July 17, 1926, the following operation for the closure of the fistula was performed. The skin flap on the outer side of the wound was dissected free and a flap of muscle, somewhat larger in diameter than the size of the fistula, was dissected from the muscles mesial to the scapula (Figs 12 and 13). The edges of the bronchial fistula were freshened with a curette and the pedicled muscle flap was turned into the fistula for a distance of one inch, so as to plug the bronchus (Fig 14). It was su-

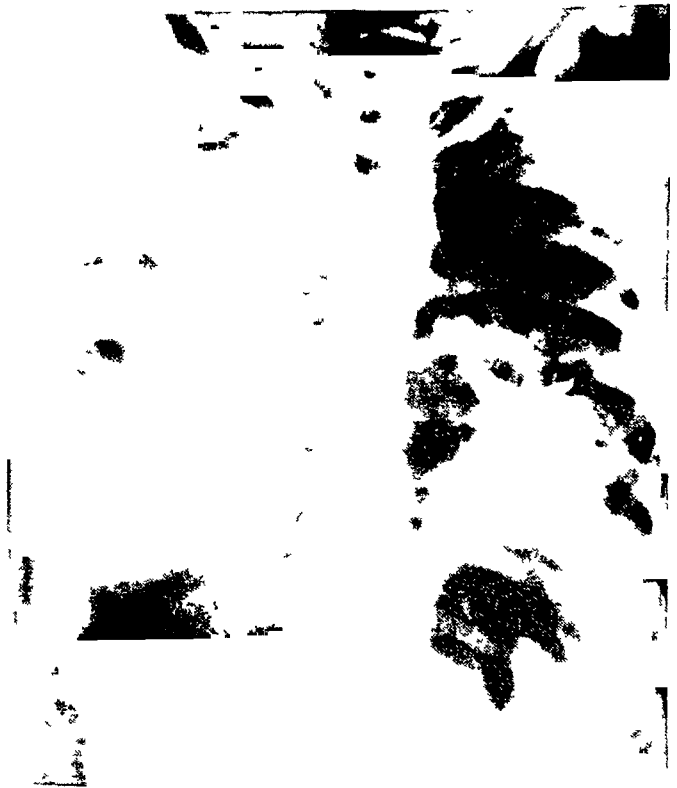


FIG 19—Case III—X-ray following injection of lipiodol into the thoracotomy wound, showing the outline of a large branch of the left lower bronchus

TREATMENT OF PERSISTENT BRONCHIAL FISTULA

These were removed in forty-eight hours. The wound healed by primary union and the patient was discharged from the hospital eighteen days later (Figs 15 and 16).

When last seen February 17, 1929, the patient said he had gained thirty pounds in weight, had returned to his former occupation and had no symptoms referable to his cardio-respiratory system (Fig 17).

CASE III—A girl thirteen years of age, was first admitted to the Medical Ward of the New York Hospital because of persistent cough, with pain in the left lower chest, of two weeks' duration. This had occurred one week after recovery from a three weeks' illness with pneumonia. Physical examination showed a moderately ill, well-developed and well-nourished girl. Temperature 103° F, white blood cells 22,250, polymorphonuclear leucocytes 87 per cent, hemo-



FIG. 20—CASE III. Lateral view of the same condition noted in Fig. 19.

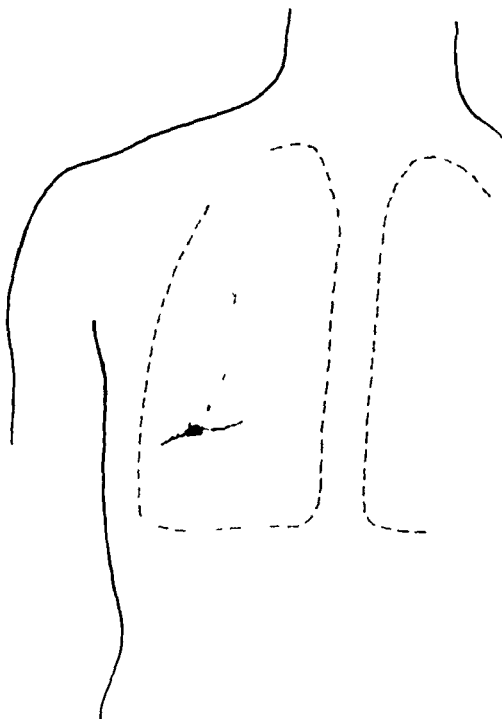


FIG. 21—CASE III. A diagrammatic sketch of the appearance of the wound before closure of fistula.

globin 74 per cent. Physical examination, confirmed by X-ray, gave the signs of fluid in the left chest. Upon aspiration, purulent material was obtained which cultured Pfeiffer's bacillus. The patient was transferred to the Second Surgical Division and on July 3, 1928, a rib resection was performed. Two rubber tubes were inserted.

After operation, convalescence was smooth, except for the fact that the wound continued to drain profusely. On the twentieth post-operative day, it was noticed that irrigation of the wound with saline solution caused severe coughing, and that the patient tasted the salt. She was discharged on the forty-fourth post-operative day with a small granulating sinus and a definite bronchial fistula.

The patient was treated at the Out-Patient Department until September 21, 1928, without any decrease in the discharge from the wound, or tendency to closure of the fistula.

She was readmitted September 21, 1928. Examination at this time showed a granulating

sinus in the centre of the thoracotomy wound which extended inward for about one and a half inches (Fig 18) X-ray after injection of lipiodol showed a bronchial fistula

involving a large branch of the lower left main bronchus (Figs 19 and 20) The thoracotomy wound was enlarged October 2, 1928, and there was found a large bronchial fistula adherent to the chest wall The wound was dressed repeatedly until it became fairly clean Because of the persistent cough and the failure

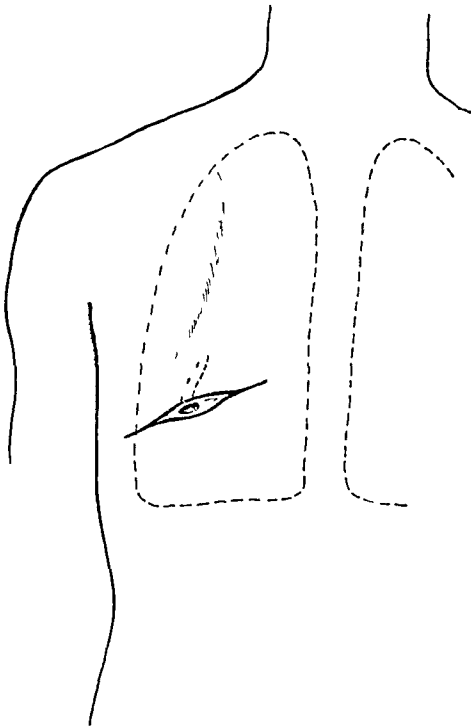


FIG 22—Case III Elliptical incision excising the scar of the former operation

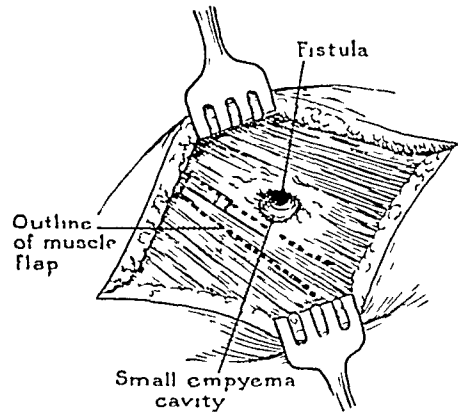


FIG 23—Case III Indicating the outline of the muscle flap to be placed into the fistula The small empyema cavity is indicated

of the fistula to close spontaneously, operative closure was decided upon

October 22, 1928, the following operation was performed An elliptical excision of

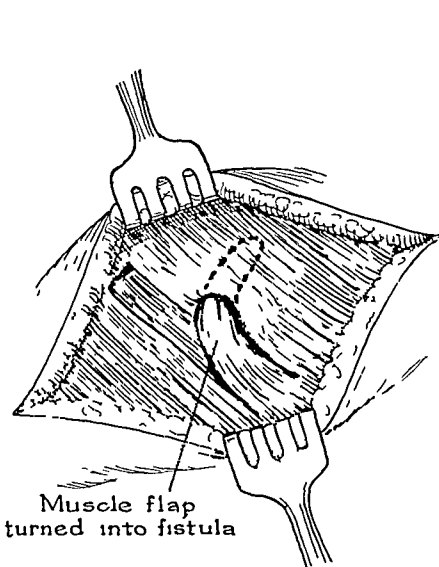


FIG 24—Case III The muscle flap has been inserted into the bronchial fistula

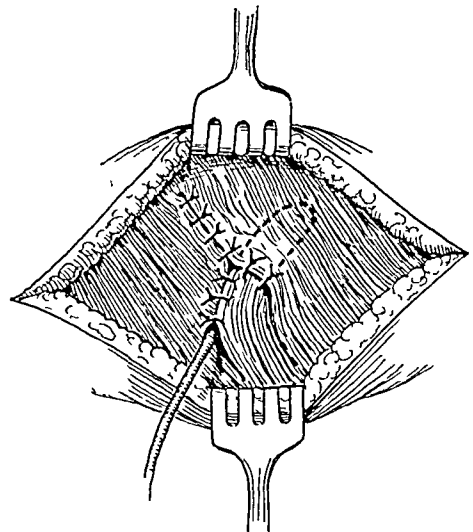


FIG 25—Case III Sutures have been placed anchoring the muscle flap to prevent dislodgment The small tube drain is indicated

the previous scar was made (Figs 21 and 22) Upper and lower skin flaps were fashioned The latissimus dorsi muscle was then isolated An empyema cavity measuring

Fig. 26—Case III. Appearance of wound eighteen days following closure of the bronchial fistula.

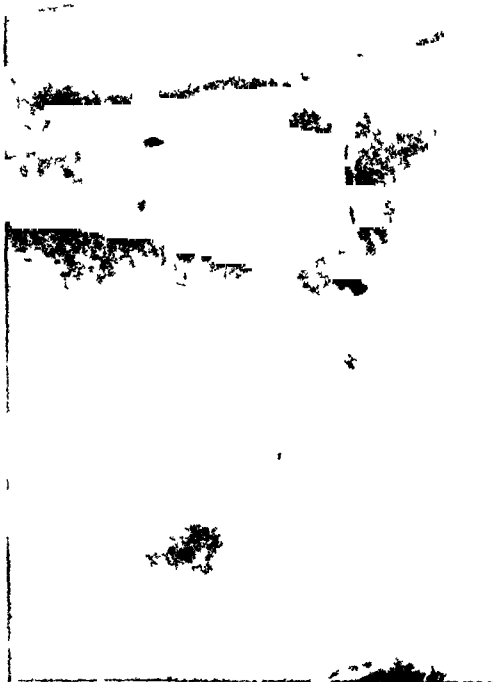


Fig. 27—Experiment 8 described in protocols. Gross specimen showing lobe of lung adherent to the parietal pleura. The adjacent ribs are included. A—Lobe of lung. B—Parietal pleura. C—Ribs.

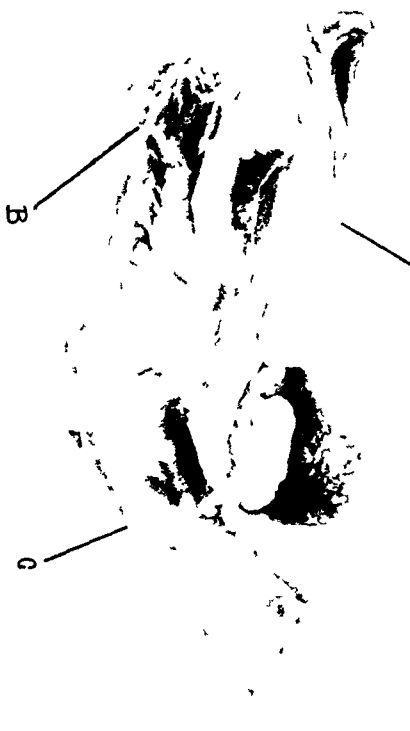


Fig. 28—Experiment 8. Longitudinal section through the specimen pictured in Fig. 27 after removal of the ribs and excess lung tissue. One may note the pedicled muscle flap, the lobe of the lung, and a large bronchus cut longitudinally and again transversely. The muscle flap may be seen within the lumen of the bronchus. A—Lobe of lung. B—Pedicled muscle flap. C—Bronchus. D—Muscle flap in bronchus.



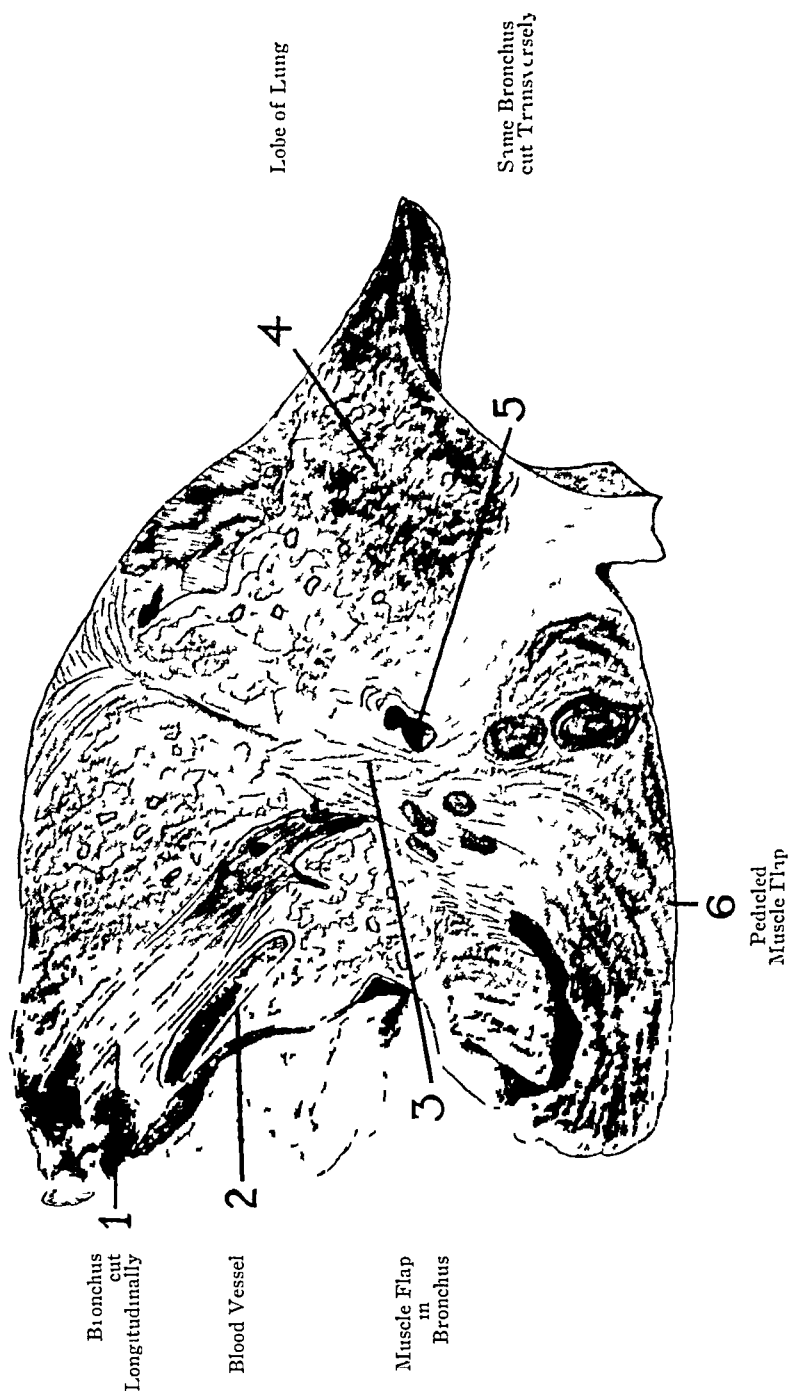


FIG 29—A diagrammatic sketch of the gross specimen pictured in Fig 28, showing the muscle flap in the lumen of the bronchus

TREATMENT OF PERSISTENT BRONCHIAL FISTULA

one centimetre in diameter was visualized. At its mesial and upper aspect was a broncho-pleural fistula measuring about one centimetre in diameter (Fig 23). A pedunculated muscle flap taken from the latissimus dorsi was then fashioned (Fig 24). It was longitudinally bisected. The smaller segment was implanted into the fistula for a distance of about half an inch, and the latter one into the empyema cavity. The muscle flap was sutured to the surrounding muscular and fascial tissue (Fig 25). Coughing did not cause extrusion of the flap. A tiny rubber tube drain was placed down to the empyema cavity behind the flap and the wound was closed with plain catgut for the deeper structures and

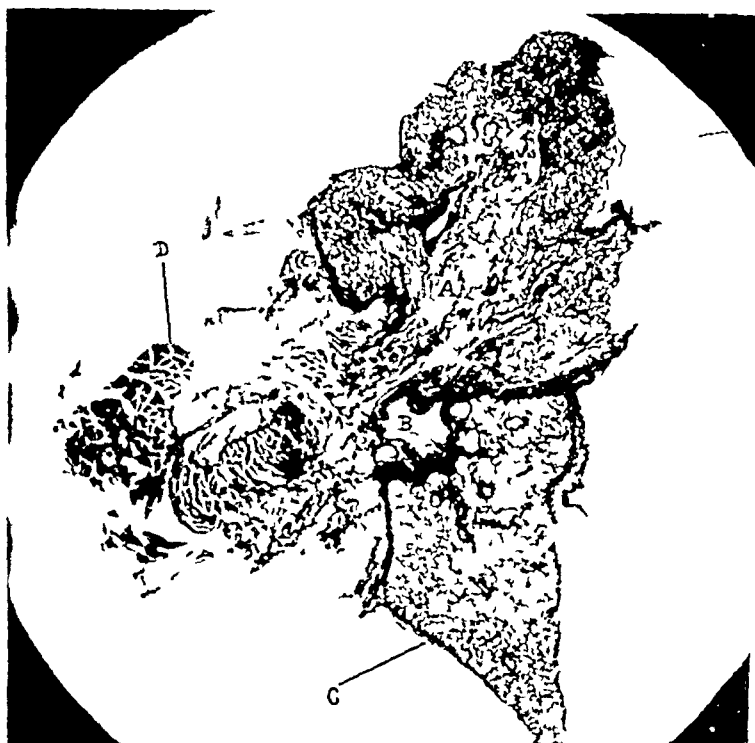


FIG 30—Microscopic section of the entire specimen pictured in Fig 29 (Magnification $\times 2\frac{1}{2}$). The pedicled muscle flap enters into the bronchus which has been cut longitudinally at one point *A* and transversely *B* at another. Beyond is seen lung parenchyma. *C*—Lobe of lung. *D*—Muscle flap.



FIG 31—Microscopic section (magnified $\times 15$) of transverse section of the bronchus, *B*, seen in Fig 30. In this section may be seen the intact striated muscle fibres of the muscle flap over which has grown the bronchial epithelium. There is a moderate amount of fibrosis. *A*—Striated muscle fibres. *B*—Bronchial mucosa.

silkworm gut for the skin. Ethylene anaesthesia, time, twenty minutes. The arm was immobilized to the side. The tube was removed on the fourth post-operative day. Convalescence was uneventful and the wound healed by primary union (Fig 26). The unusual part of the convalescence was that, following operation, the patient did not cough once, although no sedatives were administered.

When last seen, April 7, 1929, the patient had gained fourteen pounds, had returned to school, and had had no symptoms referable to her former condition.

EXPERIMENTAL DATA ‡

In order to determine what happens following the performance of such an operation, and to study

‡ From the Surgical Research Laboratories, College of Physicians and Surgeons, Columbia University, Dr. William C. Clarke, Director.

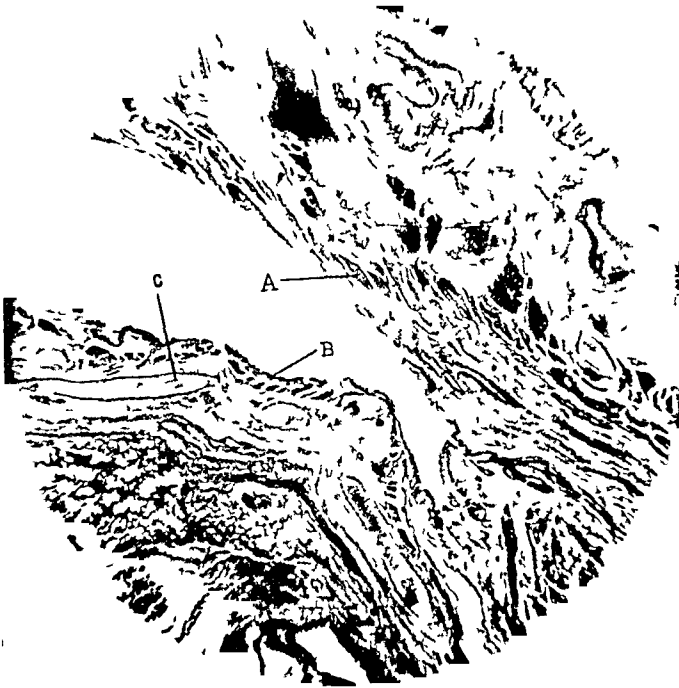


FIG 32—Another view of the longitudinal section of the bronchus *A* pictured in Fig 30 (magnified $\times 15$) showing the intact striated fibres of the muscle flap and the outgrowth of bronchial mucous membrane which has not yet completely covered the flap. The bronchial cartilages are visible. *A*—Muscle fibres. *B*—Bronchial mucosa. *C*—Bronchial cartilage.

bronchial fistula. Accordingly, fourteen dogs were subjected to the method of Cutler, Schlueter and Werdlein. We tried to follow their technique in detail, but failed to obtain a single instance of lung abscess. This may be attributed to the fact that, although numerous strains of various organisms were used, we did not employ organisms pathogenic for the dog.

The experimental production of an empyema in the dog is quite easy, but because of the high mortality rate and the fact that the production of a bronchial fistula under these conditions was not feasible, this par-

the processes of repair, experiments on dogs were undertaken. It was felt that an attempt should be made to simulate, as closely as possible, the conditions found in man with lung or pleural suppuration. From this standpoint, however, the results were disappointing. We were unable to produce chronic pulmonary or pleural suppuration. We were able, however, to determine what happens to a muscle flap which has been plugged into a bronchus. In the beginning, the idea was to produce a lung abscess, to be followed by drainage with the production of a



FIG-33—A higher power-microscopic section (magnified $\times 90$) of the bronchus pictured in Fig 31, showing the intact striated muscle fibres and the complete regeneration of the bronchial mucosa. *A*—Muscle fibres. *B*—Bronchial mucous membrane.

ticular method was abandoned

After numerous unsuccessful attempts, a method for the artificial formation of a bronchial fistula was finally evolved. It may be stated incidentally that it is extremely difficult to produce a bronchial fistula in an experimental animal because of the small size of the bronchial tree, the resulting shock when the pleural cavity is opened and in view of the fact that experimental animals especially dogs, rapidly heal any artificially produced pathological lesions.

The operative procedure finally adopted was



FIG. 34.—Microscopic section cut at a deeper level than that pictured in Fig. 30. The pedicled muscle flap within the lumen of the bronchus is clearly outlined. (Magnification $\times 2\frac{1}{2}$.) A—Bronchus cut longitudinally. B—Same bronchus cut transversely. C—Muscle flap. D—Lobe of lung.



FIG. 35.—Microscopic section of higher magnification, $\times 15$, including bronchus A and B and muscle flap, pictured in Fig. 34. This shows both sides of the sectioned bronchus with the muscle flap between. The viability of the muscle fibres is noteworthy.

as follows. The animal was anesthetized with ether. The entire left side of the chest wall was carefully prepared by shaving, scrubbing with alcohol and ether, and painting with 3.5 per cent tincture of iodine. An oblique incision about five inches in length was made along the course of the sixth rib in the posterior axillary line. The overlying muscles were retracted. The sixth rib was then exposed and removed for a distance of three inches subperiosteally. Its encircling periosteum and the adjacent

intercostal muscles were then very carefully dissected from the parietal pleura and excised, a procedure involving great care because of the ease with which the extremely thin parietal pleura may be perforated. Through the thin pleura can be seen the underlying expanded lung. Using a very fine curved needle and fine silk, stitches were taken in a circumferential manner in such a way as to catch both pleura and lung in each bite. By this method, a lobe of the lung can be sutured to the parietal



FIG 36—High magnification, $\times 90$, of one side of the bronchus *B* noted in Fig 35. The growth of bronchial mucosa over the muscle flap is here clearly demonstrated. *C*—Striated muscle fibres.

pleura without producing a pneumothorax. After inserting ten or twelve sutures, involving a surface of the lung approximately one and a quarter inches in diameter, the overlying pleura was excised and the wound was closed by replacing the retracted muscles. The skin and subcutaneous tissues were sutured with fine silk so as to produce eversion of the skin edges. A cotton-collodion dressing was applied followed by a chest bandage and the application of a canvas jacket.

Two weeks later a second operation was performed. After careful skin preparation, the scar

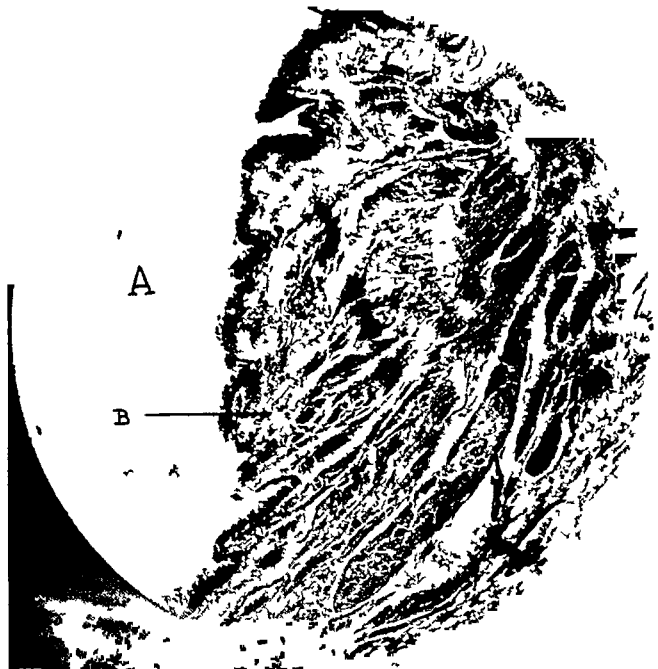


FIG 37—High magnification, $\times 90$, of the other side of the bronchus *A* pictured in Fig 35 showing the distribution of the striated fibres of the muscle flap covered by bronchial mucosa. The scarcity of fibrous tissue formation is especially noteworthy. *A*—Bronchus. *B*—Muscle fibres.

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FIG 38—Experiment 10 described in protocols. Gross specimen of lobe of lung adherent to the parietal pleura with the adjacent ribs. A—Lobe of lung. B—Ribs.



FIG 39—Another view of the specimen pictured in Fig 38, showing the external surfaces of three ribs with the pedicled muscle flap. A—Lobe of lung. B—Ribs. C—Pedicled muscle flap.

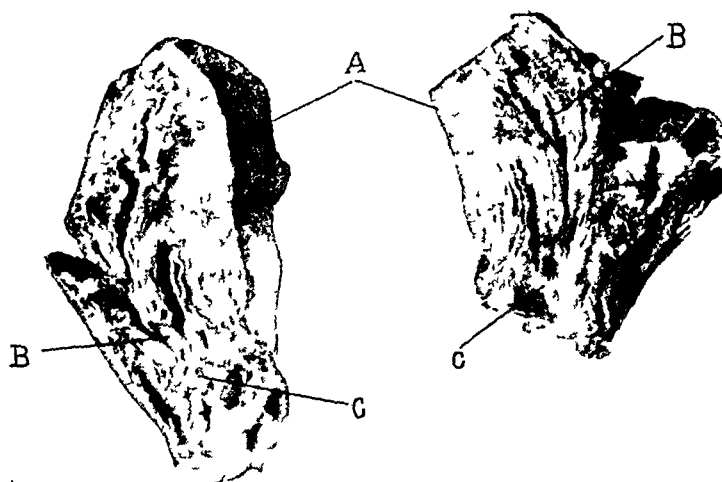


FIG 40—Longitudinal section of gross specimen pictured in Figs 38 and 39, after removal of the ribs and excess lung tissue. Here one may see a large bronchus cut longitudinally, surrounding lung tissue, and at the lower pole the pedicled muscle flap over which there has been a growth of bronchial mucosa. A—Lung. B—Bronchus cut longitudinally. C—Muscle flap.

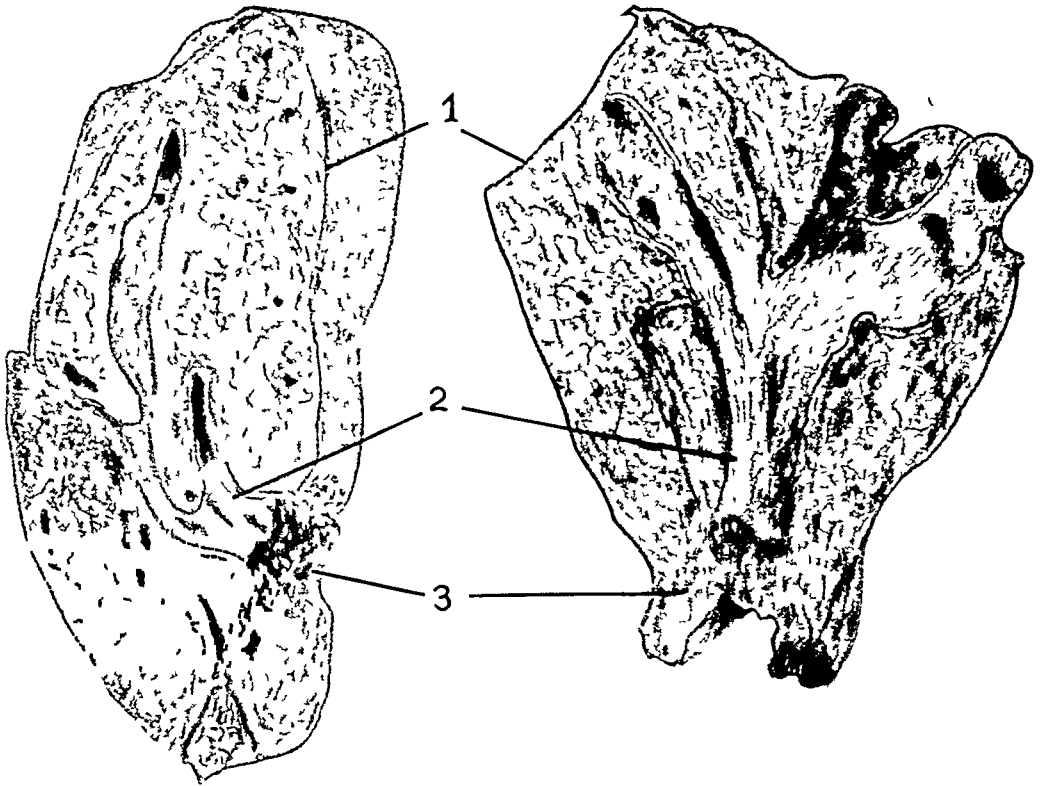


FIG. 41.—Diagrammatic sketch of the specimen pictured in Fig. 40 to clarify the details of the various components 1—Lobe of lung 2—Bronchus cut longitudinally 3—Muscle flap in bronchus

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of the former operation was excised. The overlying musculature was again retracted, exposing the lobe of the lung adherent to the parietal pleura at the rim of the opening. By blunt dissection an opening was carefully made into the substance of the lung and extended deeper and deeper until a fair size bronchus was encountered. Not infrequently, a large pulmonary vessel simulates closely the appearance of a bronchus. Therefore, in each instance, a fine aspirating needle was inserted to determine the contents of the structure isolated. When satisfied that the structure was a bronchus, stay sutures of fine silk were inserted and an opening made into it. By dissecting this structure from its surrounding lung parenchyma, considerable mobilization was obtained. A bronchocutaneous fistula was then formed by suturing the previously mobilized skin flaps to the edges of the opening in the bronchus with fine silk. A sterile dressing was then applied and held in place by bandage and a canvas jacket.

During the following ten days the wound was dressed daily. At each dressing, bronchial secretion which tended to occlude the opening was carefully wiped away. Every other day during this period the bronchus was cauterized with carbolic acid followed by alcohol. The purpose of this procedure was to cause a denudation of the bronchial mucosa. It was necessary to perform the final stage within the ten-day period in order to prevent the spontaneous closure of the fistula.

At this last operation, the scar was excised and the skin separated from the adherent bronchial opening which, by this time, had become fairly well fixed near the periphery of the lung. A pedunculated flap of muscle, corresponding to the size of the fistula, was then fashioned from the latissimus dorsi muscle which had been previously preserved intact. This flap was tubularized by approximating the lateral edges with fine plain catgut sutures. It was then placed deeply *into the bronchus* for a distance of one-half to three-quarters of an inch and held in place by fine catgut stitches placed in the muscle and the rim of the fistula. The remainder of the muscle flap was anchored to the surrounding structures with silk sutures so as to avoid strain on the flap when the animal was up and about. The remainder of the wound was then closed without drainage, care being taken to obliterate all dead spaces. A sterile dressing and canvas jacket were then applied.

While this procedure was carried out in ten dogs, in only two were satisfactory specimens obtained. These dogs lived ten months and one year respectively. Their protocols are herewith appended.

PROTOCOLS

Experiment 8—No. 9499, female collie. *First stage operation*, December 22, 1927. Ether anaesthesia. Left chest wall prepared as above described. Three inches of the fifth rib excised through an oblique incision. Intercostal muscles and periosteum dissected from parietal pleura and excised, leaving an opening about one and a quarter inches in diameter. Interrupted sutures of fine silk were then placed circumferentially, uniting lobe of lung to the parietal pleura. The overlying retracted muscles were then replaced and the skin closed with silk.

Second stage operation, February 1, 1928 The scar of the former operation was excised. Overlying muscles retracted, exposing adherent lobe of lung. By blunt dissection, a hole was made into the substance of the lung until a large bronchus was isolated. It was aspirated with a fine needle. Stay sutures of silk were inserted and an opening made into the bronchus, approximately three-eighths of an inch in diameter. The bronchus was mobilized by freeing it from its surrounding tissues and sutured to the edges of the skin flaps. The remainder of the wound was then closed with fine catgut for the muscles and silk for the skin.

February 2, 1928, wound dressed. Fistula patent. Bronchial secretion wiped away.

February 3, 1928, phenol and alcohol applied to fistula.

February 5, 1928, phenol and alcohol again applied to fistulous opening.

February 7, 1928, phenol and alcohol again applied.

Third stage operation February 10, 1928 The scar of the previous operation was excised, freeing the skin edge from its attachment to the bronchial opening. Skin flaps were then fashioned and the latissimus dorsi muscle isolated. A pedunculated muscle flap was then freed and fashioned into a tube measuring about three-eighths of an inch in diameter. It was then turned into the bronchus for a distance of one-half inch and anchored to the rim of the bronchial opening with interrupted sutures of fine catgut. The remainder of the muscle flap was then anchored to the surrounding structures by inserting interrupted sutures of silk. All dead spaces were obliterated and the wound closed without drainage.

This animal was killed on February 1, 1929, one year after the last operation. At autopsy, the broad surface of the middle lobe of the left lung was found firmly adherent to the parietal pleura. After separation of the skin and subcutaneous tissues, the muscle flap was isolated. The entire specimen was excised for study. (Fig 27.)

The adjoining ribs and excess muscle and lung tissue were removed. The plugged bronchus was then isolated by carefully opening the bronchial tree from the main bronchus as a starting point. When the occluded bronchus was seen, the specimen was bisected longitudinally at this point. The cut gross section is shown in Figures 28 and 29. It will be seen that the main portion of the bronchus has been cut longitudinally. Entering into the bronchus is a small muscle flap, and below this point the same bronchus has been cut transversely. The muscle flap was found firmly united to the wall of the bronchus, and, in the gross, there was evidence of the outgrowth of bronchial epithelium to cover the muscle flap. There was little to indicate inflammatory reaction in the adjacent lung parenchyma.

Microscopic sections of the entire cut surface were then made (Figs 30, 31, 32, 33, 34, 35, 36, 37.) Dr. Gilbert Dalldorf of the pathological department, at New York Hospital, has kindly examined these sections and his report follows: "The specimen is an equilateral triangle, about four centimetres on each side. The lower part is lung parenchyma and a transverse line separates this from the triangular mass of muscle tissue. At about its mid-point the muscle tissue is seen to enter a distended bronchiole which appears distorted. The muscle is largely intact, but in places, alternates with fibrous tissue. Although the relationship between this bronchiole and the smaller ones is asymmetric and unnatural, all of these structures, however, are normal in the sense that their walls are intact and lined with tall columnar epithelium. The bronchiole which contains the muscle is distended, the lumen measuring roughly three by four millimetres. There is practically no inflammatory reaction either in the lung or the muscle flap. With the operative procedure as described, it seems reasonable to assume from examination of the specimen, that there has been a growth of bronchial epithelium over the sides of the muscle flap lying within the lumen of the bronchus."

Experiment 10—No 9731 Male Irish terrier. *First stage operation*, February 28, 1928. Ether anaesthesia. Left chest wall prepared as above described. An operation identical with the one described under Experiment 8 was performed.

Second stage operation March 9, 1928—The scar of the former operation was

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excised and the adherent lung visualized by retraction of the overlying muscles. A hole was then made bluntly into the substance of the lung until a large bronchus was isolated. This bronchus ran in a somewhat vertical direction. After mobilization from the surrounding lung parenchyma, stay sutures were applied and the bronchus drawn up into the wound, thus creating a Y formation. The edges of the opening in the bronchus, which measured three-eighths of an inch, were sutured to the edges of the skin flaps with silk. The remainder of the wound was closed as above described.

March 10, 1928, wound dressed. Bronchial secretion which tended to plug the opening removed, reestablishing a flow of air.

March 12, 1928, bronchial secretion removed. Carbolic acid and alcohol applied to the fistula.

March 14, 1928, phenol and alcohol again applied. Fistula patent.

March 16, 1928, phenol and alcohol again applied. Strong flow of air noted.

Third stage operation, March 18, 1928. The scar of the previous operation was excised, liberating the skin edge from its attachment to the bronchial opening. Skin flaps were then dissected and the latissimus dorsi muscle isolated. A pedunculated muscle flap was then formed and split longitudinally. Each segment of the split flap was then rolled into a tube and inserted into the two limbs of the Y-shaped fistula. The flap was then anchored to the rim of the fistula with fine catgut. The remainder was sutured to the surrounding structures to prevent dislodgment. All dead spaces were obliterated and the wound closed without drainage.

This animal was killed on December 26, 1928. At autopsy, the broad surface of the middle lobe of the left lung was found firmly adherent to the parietal pleura. The adjacent ribs, the lobe of the lung, and the overlying musculature were excised *en masse* for study. (Figs 38 and 39.)

The adjacent ribs and the excess lung and muscle tissue were excised. The plugged bronchus was isolated by careful dissection of the bronchial tree from its origin. When this point was reached, the entire specimen was bisected longitudinally. The gross cut section is shown in Figures 40 and 41. It will be seen that the bronchus has been divided longitudinally. At its lower extremity is a section of the muscle flap which lies firmly united to the interior of the bronchus at this point. In the gross, the outgrowth of bronchial epithelium to cover the surface of the muscle flap is clearly indicated. There is no evidence of inflammatory reaction in the lung parenchyma.

CONCLUSIONS

1. Bronchial fistulas occur most commonly with empyema thoracis and lung abscess.

2. The majority close spontaneously.

3. Persistence of a fistula may be due to suppuration in the parenchyma of the lung or the bronchial tree, the presence of a rigid-walled empyema cavity into which the fistula opens, the formation of a broncho-cutaneous channel or the presence of a foreign body.

4. Operative closure of a bronchial fistula should not be attempted until the need for drainage of a lung suppuration has passed.

5. Very small fistulas will frequently close following the local application of some cauterizing agent.

6. For the closure of a bronchial fistula which persists in spite of conservative measures, an operative procedure is described. This consists in plugging the fistula with a pedunculated muscle flap. The operation is simple, of wide application, and has proved successful in our experience.

7 The production of a bronchial fistula in an experimental animal is attended with great technical difficulties

8 Although the experimental data herewith reported do not duplicate exactly conditions as found in man, the results obtained indicate clearly the processes of repair following closure of a bronchial fistula by the method described

9 A muscle flap placed into a bronchial fistula to effect its closure remains viable and is not completely replaced by fibrous tissue Microscopic examination shows intact muscle fibres at the end of a year

10 The sections further disclose the growth of bronchial epithelium over the muscle flap

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SUBPHRENIC ABSCESS ¹

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SINCE Barlow's original paper, published in the *London Medical Gazette* in May, 1845, describing subphrenic abscess the condition has been occasionally mentioned in medical literature, but no great interest appears to have existed until Leyden, in 1880 described the disease, its symptoms and signs. Since that time the pathology, signs and symptoms have been described by many eminent writers. In the present paper I desire only to call attention to the more important phases of the subject.

In a general way one considers a subphrenic abscess as a localized inflammatory process in one of the many spaces of the upper abdomen between the diaphragm above and the transverse mesocolon below while in reality a true subphrenic abscess is located between the domed surface of the liver below and the diaphragm above but the latter classification would exclude many collections of pus which are generally known as subphrenic abscess. The liver and its coronary ligament divide this area into an anterior and posterior space. The upper part of the subphrenic space is further divided into a large right, and a small left, space by the suspensory or falciform ligament. The liver also divides this space into a suprahepatic and infrahepatic space. There is an extraperitoneal space which is situated between the folds of the ligaments of the liver. Some knowledge of these spaces is necessary in order to locate and properly treat an abscess in this locality.

The vast majority of abscesses occur in the right side, although one is occasionally found in the left side as a complication of a perforation of the stomach, or from pancreatic, splenic or renal infections. The germ most frequently found appears to be the colon bacillus, although it is not uncommon to find the streptococcus, staphylococcus, pneumococcus, pyocyaneus and rarely the Welsh or tubercle bacillus.

In a review of twenty-four cases of subphrenic abscess which I am able to find from the records of the Post-Graduate Hospital covering the years from 1914-1928, there are six cases of subphrenic abscesses complicating appendicitis, six cases complicating gall-bladder disease, four cases associated with pneumonia, empyema or pleurisy, two cases following perforated duodenal ulcers, two cases following trauma to the upper abdomen, of which one followed rupture of the liver, and the other a simple contusion of the upper abdomen with the development of an abscess which was opened thirteen days later. Of the remaining two cases, one case is reported as being due to exposure, and the other to abscess formation with actinomycosis of the right pleura and subphrenic space, apparently actinomycosis of the hepatic flexure of the colon with extension through the lymphatics of the diaphragm. For

* Read before the New York Surgical Society, March 27, 1929.

the reviews of these cases I am indebted to the visiting surgeons of the Post-Graduate Hospital

Most authorities cite perforations of the pylorus and duodenum as the most frequent causes, and disease of the appendix as second in frequency. Trauma is rarely mentioned as a cause, yet in this small series it is thought to be responsible in two cases. A very frequent cause is the appendix which may produce either the intraperitoneal or extraperitoneal abscess. The infection travels up behind the colon from a retrocæcal appendix, or it may extend up the sides or in front of the ascending colon.

Peristaltic action of the colon is believed to aid in carrying the infection to the under surface of the diaphragm. Likewise, a perinephritic infection may spread upward, or an empyema of the chest may perforate the diaphragm though it is more probable that a subdiaphragmatic infection may spread upward through the lymphatics of the diaphragm, especially on the right side, and be the cause of a prolonged empyema of the pleura.

General peritonitis from any cause may result in the formation of pus beneath the diaphragm, and I believe this to be the cause in the majority of these abscesses. The worst case I encountered occurred in a patient upon whom I operated for a suppurative pancreatitis associated with a gangrenous cholecystitis.

Rupture of an abscess of the liver was the cause in another case. Many cases thought to be abscesses of the liver may prove to be subphrenic abscess eventually.

Gas is sometimes found as well as pus in the abscess and denotes the presence of a perforation of a hollow viscus or a gas-producing infection such as the *aerogenes capsulatus* or the more frequent colon bacillus. The pus has a very foul odor in all the cases I have encountered. Subdiaphragmatic abscess may develop rapidly after an abdominal infection or it may be very insidious in its formation, occurring months, or possibly a year or more, after the original infection.

I believe it to be a more frequent condition than it is generally supposed and that numbers of small abscesses develop in this locality which are never recognized and which clear up without surgical intervention by absorption of the pus. Mechanical factors, due to anatomical position and vitality of the patient, favor spontaneous absorption. I have found small collections of pus high in the abdomen on the under and posterior surface of the liver in two cases upon which I have operated shortly after operations have been performed for cholecystitis. In neither case were there recognizable symptoms of the infection. In one of these cases I operated to remove a large stone in the lower end of the common duct eight weeks after the cholecystectomy had been performed and found fully two ounces of pus. The patient did not have elevation of temperature nor any symptom except recurring attacks of pain and marked jaundice from obstruction of the duct by a stone.

When symptoms of disease in the lower part of the chest or upper part of the abdomen appear following an acute or chronic abdominal disease we

should suspect subdiaphragmatic abscess. The symptoms are almost always associated with or closely resemble those found in diseases of the lower part of the thorax. The patient is septic; there is pain in the epigastrium, right or left hypochondrium or the lumbar region. More pronounced, in my own observation, in the lumbar region and referred upward between the scapulae. Considerable emphasis has been laid on pain referred to the end of the twelfth rib. The pain is sharp and pleuritic in character and usually requires opiates to give relief.

In an abscess on the right side a perihepatitis is usually present, also there are râles in the lower chest. Rarely an associated pleurisy with effusion is found which makes the condition all the more difficult to diagnose. There is elevation of temperature, usually of the septic type, which begins sometime after the temperature from the abdominal disease causing the abscess has been normal.

The temperature may remain normal for months and the patient completely recovered from the former illness before there is sudden appearance of pain, elevation of temperature, leucocytosis, and other symptoms denoting a severe infection. This occurred in one of my own cases. During the month of March, 1921, I operated upon a patient, thirty-eight years of age, for a perforated duodenal ulcer. The patient made an uneventful recovery, gained forty pounds in weight and appeared to be perfectly well until the 25th of the following October, when he became ill with pain in the upper abdomen referred to the back, fever of the intermittent type and rapid loss of weight. I saw him on November 18, and operated upon him for a large subphrenic abscess.

In two of the twenty-four cases studied from the Post-Graduate Hospital series the abscesses developed in one case a year after pneumonia and pleurisy with effusion, and in the other seven years after an empyema operation without apparent later cause.

Paralysis of the diaphragm with depression of the liver may be an early symptom if the abscess is intraperitoneal. The liver does not move up and down freely with respiration and there may be jaundice or the so-called purulent complexion.

Differential diagnosis between subdiaphragmatic abscess and lung or pleural infections is most difficult. In abscess there is dulness on percussion in the lower part of the chest which may extend from the third rib anteriorly to Poupart's ligament. The dulness is higher in front and lower behind. The upper line of dulness is not as well defined as in pleurisy with effusion, and change in position of the patient does not effect the area of dulness. The chest movements are not impaired to the same extent as in pleurisy with effusion.

The heart is not displaced unless there is an associated pleurisy with effusion. If gas is present in the abscess there is dulness above the tympany found over the gas area. The presence of hiccoughs is highly suggestive of a diaphragmatic lesion.

Rapid breathing associated with cough and expectoration are not marked symptoms if present at all. There is usually rigidity with a sense of fulness in the upper abdomen either on the right or left side, and tenderness over the affected side is frequently seen.

When a subdiaphragmatic abscess is well developed the prognosis is grave. Most authorities quote the mortality rate from 20 to 50 per cent. This is a disease in which time is a vital factor, hence early recognition with proper treatment should, and no doubt will, lower the former high mortality rate.

For years it has been common practice to employ the aspirating needle in making the diagnosis. I am glad this practice is going out of fashion. I cannot lay sufficient emphasis on the futility of this custom. I have never been able to see any more reason for aspirating a suspected subphrenic abscess than for aspirating a suspected pelvic or appendix abscess, the practice of which has been abandoned for the past forty years. This use of the aspirating needle is condemned in almost every recent article I have been able to find upon this subject. It is, however, occasionally used and I think rightly so, to aspirate the pleural cavity when there are symptoms indicating fluid or pus in the pleura. Otherwise the use of the exploratory needle for lesions with vague anatomical locations should be abolished and replaced by the proper application of up-to-date X-ray methods, particularly when obtained by the cooperation of the roentgenologist and surgeon.

I have found X-rays to be of especial value in differentiating subphrenic abscess when, in addition to the usual anteroposterior view in the sitting and prone position, an exposure is made using as the centre of the focus the lateral border of the chest wall approximately on the level of the costophrenic sinus. An exposure made in this way will eliminate the possibility of the shadow of an abscess below the diaphragm pushing up this structure so as to obscure the costophrenic sinus. I recall a case in which numbers of aspirations of the pleural cavity had failed to find fluid when finally an X-ray was taken as described above which showed the lower pleura to be perfectly free of fluid. If the patient is too ill to sit up in the erect position for X-ray it is sometimes helpful to make an exposure with the patient lying on the side as suggested by Douglas.

I can see no objection to an abdominal exploration under local or spinal anæsthesia in a case of suspected subphrenic abscess.

In 1908 Dr John W. Keefe, of Providence, read a paper before the twenty-first annual meeting of the American Association of Obstetricians and Gynecologists, in which he strongly advocated the use of an exploratory abdominal incision in the epigastrium or through the right or left upper rectus muscle "to form a correct conception of the abnormal condition present and the altered position of the viscera."

I have watched Dr John F. Erdmann employ this procedure for the past twenty years and have used it in all cases that I have operated upon myself with gratifying results.

The use of this incision certainly gives most valuable information as to

the best methods of opening and draining the abscess. When the abscess is located, if it is thought wise to drain through the abdomen the viscera are walled off with saline pads and great care is exercised to use suction to remove the pus without much spilling, which can be easily done by employing the ordinary suction tube such as is used by the laryngologist, rather than the ordinary instrument sometimes used for abdominal suction. Then a counter incision is made between the ribs in the lateral or posterior wall of the upper abdomen and through-and-through drainage instituted, or only the latter incisions may be used for drainage in which case the abdominal wound is closed. It is also possible in some cases to make an incision along the costal border down to the peritoneum, then strip the peritoneum down and enter the abscess extraperitoneally. I have recently employed this incision in opening a large abscess in a patient, sixty-eight years of age, who developed an abscess in the right subphrenic area three years after a primary operation for cholecystectomy. This patient drained bile and pus for a long time after the gall-bladder operation and finally healed, but was in poor health until the subphrenic abscess was drained October 23, 1928. The patient was discharged from the hospital November 5 with wound practically healed. It does not appear to me to be good surgery to make a routine practice of resection of the ribs for this condition in a patient who is already in a debilitated state, thereby adding additional shock which frequently results in death.

Some cases can be drained through an intercostal incision between the ninth, tenth or eleventh ribs if there is definite evidence that pus is present in the posterior space, but if this is done the simple intercostal incision is employed and a double rubber tube introduced into the abscess cavity until the patient's condition is improved and it is rarely necessary to do a later resection of the ribs to get a sinus to heal.

I cannot see the necessity for opening the pleura for draining a subphrenic abscess. If an empyema is present the pleura is drained through the same incision puncturing the diaphragm or through a higher intercostal incision. Every authority who quotes statistics gives the highest mortality rate in operations in which the transpleural route has been employed.

CONCLUSIONS

- 1 Subdiaphragmatic abscess defies early accurate diagnosis insofar as the anatomical location and pathogenesis is concerned.
- 2 The customary use of the exploratory needle is misleading and dangerous.
- 3 Early recognition and proper surgical treatment should reduce the high mortality rate so far reported.
- 4 A broader and safer surgical measure is afforded by the transabdominal, than by the hazardous transpleural, route.

GONORRHOÆAL INFECTION OF ABDOMINAL WOUNDS FOLLOWING LAPAROTOMY

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WHILE metastatic suppurative processes may frequently be caused by the gonococcus, wound infection with this organism is one of the rare complications of gonorrhœa, and one which has received little attention in the literature. By nature especially adapted to serous and mucous surfaces, the gonococcus finds its usual habitat in the genito-urinary tract, the synovial membranes, and the conjunctiva. More rarely it is the cause of peritonitis, pericarditis, and endocarditis, and still more rarely is responsible for lesions of the muscles and skin.

The presence of the gonococcus in a wound was noted by Stephens¹ in a man of twenty-seven. This patient had gonorrhœa at the age of seventeen, but at the time of observation had no symptoms of the disease. He received a gunshot wound necessitating amputation of the right thigh. The day following this operation hot salt solution caused a second degree burn three inches in diameter on the left thigh. This lesion advanced to chronicity, showed undermining of the edges, was covered by thick yellow pus, and at eight weeks showed no tendency to heal. Smears from the lesion showed Gram-negative intracellular diplococci which failed to grow on plain agar, blood serum, and blood agar, but grew slowly on blood-streaked agar. The organisms failed to ferment glucose, but agglutinated with the serum from a known case of gonorrhœa. The wound rapidly improved under treatment with 10 per cent silver nitrate and 10 per cent silvol. In discussing the case Stephens states that the probable source of infection was through instruments, dressings, or the hands of the attendant.

A second case is recorded by Kingsbury²

A physician sustained a slight abrasion of the elbow and a few days later operated on a patient who at the time had a vaginal discharge. A week after the original injury and three days after the possible exposure to gonococci, he complained of pain in the elbow. The original slight abrasion became a shallow ulcer 2.5 by 1 centimetre in diameter surrounded by a reddened area two centimetres in width. Circumscribing this latter, several large bullæ appeared and the axillary glands became large and tender. Smears of this lesion showed Gram-negative intracellular diplococci and cultures showed, in addition to a few staphylococci, a Gram-negative coccus which failed to grow on plain agar, failed to ferment maltose and saccharose, but fermented dextrose. The lesion healed in three weeks with fomentations and protargol applications.

In November, 1927, in examining a routine wound culture from the surgical service Gram-negative diplococci were found. These were intracellular in the direct smear and grew only on enriched media. Further studies showed this organism to be gonococcus.

A second and similar case presented itself in March, 1928. In this case also we were able to demonstrate the gonococcus in the pus from an abdominal wound.

CASE I—A single girl, twenty-two years of age, entered the Emergency Ward of the Massachusetts General Hospital November 16, 1927, complaining of lower abdominal pain of twelve hours' duration. On rising in the morning the patient had felt nauseated and ate little breakfast. At 10 00 A. M. she had sudden, severe, cramp-like pain in her lower abdomen which doubled her up and was felt about equally in both lower quadrants. The pain steadily became worse and was somewhat intermittent in character, appearing in acute spasms. She vomited four or five times during the afternoon, and the pain gradually became localized in the right lower quadrant.

Her bowels had been regular and the movements normal in character. There had been no frequent or burning micturition. The patient denied vaginal discharge. Her periods were always regular, she had just finished her past period which had lasted four days, was on time, and the flow normal and of the usual character and amount. During the last few periods, however, the patient had noticed cramp-like pains in both lower quadrants. This was unusual for her.

Physical examination revealed a healthy girl, of normal development. There was marked tenderness and moderate spasm in her right lower quadrant in region of McBurney's point and extending well down to the suprapubic region. The introitus admitted one finger with ease. There was very little discharge. The uterus was normal in size, shape, and position and was freely movable. There was marked tenderness in the right vault. The left vault was negative. Rectal examination revealed tenderness on the right side of the pelvis. The temperature was 102° F. by rectum. White blood cells, 32,000. Urine negative. It was thought best to explore the patient because we were not certain of the diagnosis of acute salpingitis as many features of the case favored a diagnosis of acute appendicitis.

Under ether anaesthesia a right paramedian incision was made. Both tubes were injected, tortuous, and oedematous. A small quantity of thick pus was expressed from each and a culture taken. The appendix was normal. It was removed in the routine manner and the wound closed without drainage.

The convalescence was uneventful until the fifth day, when the patient began to run a temperature up to 101° to 102° daily. The wound was obviously infected and a large amount of bloody pus evacuated from the oedematous tissues on the fifth day. Smears of this pus showed Gram-negative intracellular diplococci, and a pure culture of gonococcus was grown from this, as well as from the pus obtained from the tubes at the time of operation.

The abdominal wound was Dakinized and the sepsis cleared up in about three weeks. Ten per cent argyrol instillations were also used. Cultures taken from the wound three weeks after operation were negative for gonococci. The patient was discharged on the twenty-fifth day. The infection in this case was subcutaneous and superficial to the fascia.

Bacteriologic Studies—Pus taken from the Fallopian tubes at the time of operation and planted upon ascitic agar and blood agar showed at the end of twenty-four hours' incubation a scattered growth of small grayish colonies containing Gram-negative diplococci. The colonies were at first quite small, but on incubation for a second twenty-four-hour period increased in size, became lightly granular, and showed a somewhat lobate to serrate edge. The organism grew best on ascitic agar, very slowly on blood agar, and not at all on plain agar. It fermented dextrose and failed to ferment maltose or saccharose. It agglutinated in dilutions of from 1/20 to 1/160 with serum from a rabbit previously immunized with several gonococcus strains, and failed to agglutinate with normal rabbit serum in corresponding dilutions.

Seven days after operation, a smear from the abdominal wound showed large numbers of intracellular Gram-negative diplococci. Cultivation, sugar fermentation, and subsequent agglutination showed these organisms to be gonococci.

Twenty days after operation gonococci could not be found.

It is interesting to note that in this case we were unable at any time to demonstrate gonococci from the cervix or urethra.

GONORRHOEAL INFECTION OF ABDOMINAL WOUNDS

CASE II A single girl, twenty-three years of age, entered the Emergency Ward of the Massachusetts General Hospital March 4, 1928, complaining of abdominal pain of twelve hours' duration. At 4 00 A M on the morning of entry the patient awoke from a sound sleep with generalized lower abdominal pain, steady in character, quite severe, and lasting about fifteen minutes. The pain continued intermittently up to the time of entry with an increasing tendency toward localization in the right lower quadrant. There was no nausea or vomiting. No history of abnormality of bowel movements or urinary frequency or burning was obtained. No leucorrhœa had been noted by the patient. Her periods were regular and normal in every way and not accompanied by pain. The patient had never had a similar attack before.

Physical examination revealed a girl of normal development. Her face was flushed. There was marked tenderness and moderate spasm localized over McBurney's point over an area which could be covered by the tip of one finger. The introitus admitted one finger with ease. No unusual discharge was noted. The uterus was normal in size, shape, and position and was freely movable. The vaults were negative. Rectal examination was also negative. The temperature was 102° F by rectum. White blood cells, 11,000. The urine (catheter specimen) was loaded with pus. An X-ray of kidney regions was negative for stone.

We were unable to make a differential diagnosis between appendicitis, salpingitis, and pyelitis, so exploration was deemed best. Under ether anæsthesia an incision was made along the outer border of the right rectus muscle. The appendix was normal. Exploration of the pelvis revealed no free fluid, no thickening of the tubes, and no adhesions. The end of the right tube was brought into the wound but nothing abnormal was noted. The appendix was removed in the usual manner and the wound closed without drainage, the post-operative diagnosis being pyelitis.

On the fourth day after operation the patient began to run a daily temperature of from 101° to 102° F. No noteworthy change was noticed in the wound until the eighth day when it became obvious that there was a large subcutaneous collection of fluid. On this day a large amount of bloody serum was evacuated. A pure culture of gonococcus was grown from this material. Cervical smears were then obtained which were also positive for gonococcus by Gram's method of staining. Urine examination on the twelfth day was negative. The wound was treated by the Dakin-Carrel method and instillations of 10 per cent argyrol. The active sepsis disappeared in about two weeks and the patient was discharged from the hospital on the twenty-eighth day. In this instance the infection was also confined to the subcutaneous tissue.

Bacteriology—A routine swab taken eight days after operation from the abdominal wound showed large numbers of intracellular Gram-negative diplococci which on culture grew well on ascitic agar, and fresh rabbit blood agar. These organisms fermented dextrose, but not maltose or saccharose and agglutinated with the immune rabbit serum in dilutions up to 1/640. A prozone of inhibition was noted in the first dilutions—a well-marked inhibition in the 1/10 dilution and slight inhibition at 1/20. Normal rabbit serum agglutinated the organisms in dilutions of 1/10, but not in the higher dilutions.

From both the cervix and the urethra we were able to demonstrate the presence of gonococci both by smear and by culture.

Discussion—The symptoms of these two cases of acute salpingitis simulated those of acute appendicitis to such an extent that the differential diagnosis between these two conditions seemed hinged upon the findings at operation. In the first case the diagnosis was evident after exploratory laparotomy, but in the second case even after thorough exploration and careful examination of the Fallopian tubes, it was impossible to say that they were abnormal, yet they were evidently the seat of a very acute salpingitis, so early in all probability that the usual gross picture of an older process was

entirely absent In this latter case, only by bacteriologic studies was the diagnosis made

As to the source of the wound infection there is no direct proof It is probable that in both these cases the organisms were introduced into the wound at the time of operation, remained latent for a short time, and by their increasing activity caused the mildly septic temperature and the obvious infection which became noticeable on the fourth and fifth days, respectively There is, however, the more remote possibility of contamination of the wound by indirect infection from the genitalia

Although no secondary cases were noted which could be ascribed to either of these contaminated wounds, as a general principle it should be borne in mind that the discharges, the dressings, and the instruments employed in caring for such cases are potential sources of similar infection in the hospital ward The rapid spread of gonococcus infection from patient to patient even under the most exacting precautions is well known and justly feared, especially by those caring for female children in an open ward

From the two cases presented and from the two which are reviewed above we may draw the conclusion that the duration of infection is more appreciably shortened by treatment with the silver compounds commonly used in this disease than by any of the more common and less specific antiseptics used as dressings

SUMMARY

Two cases of acute salpingitis simulating appendicitis are presented The unusual feature in both cases was a secondary infection of the laparotomy wound with the gonococcus Fever and visible wound infection were present four and five days post-operatively In one of these cases the diagnosis of salpingitis was obvious, in the second it was made only by bacteriologic studies Dakinization of these two wounds and their further treatment with 10 per cent argyrol rapidly freed the lesions of gonococci

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LYMPHOSARCOMA OF THE GASTRO-INTESTINAL TRACT

WITH A REPORT OF THIRTEEN CASES *

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LYMPHOSARCOMA of the gastro-intestinal tract cannot be considered as rare in occurrence, still it is so uncommon that isolated case reports are constantly appearing in the literature. There is wide variation in opinion regarding this condition, especially concerning the classification of various forms and its relation to other types of lymphatic tumors. Minot and Isaacs¹ have suggested the use of the terms lymphoblastoma or malignant lymphoma to include all types of malignant lymphatic tumors, and others have adopted the same nomenclature. Under this name they include (1) lymphatic leukæmia, (2) pseudo-or aleukæmic lymphatic leukæmia, (3) Hodgkin's disease, and (4) lymphosarcoma. There are considerable grounds for this classification as Ewing,² in considering the etiology, says "It seems possible that in tuberculosis may eventually be found a connecting link between lymphæmia, pseudoleukæmia, some cases of Hodgkin's disease and some forms of lymphosarcoma." However, due to this variation in terminology, and also to the fact that many cases are reported either with no or only partial microscopic diagnosis, a complete tabulation with resultant conclusions is impossible. Many fibromyosarcomas are erroneously classed with the lymphatic tumors. We have two such cases, a brief resumé of which is given later.

Ewing² describes lymphosarcoma as a true malignant neoplasm arising in lymphatic tissue from proliferation of typical lymphocytes, and occurring as either a localized or diffuse process. In the stomach sarcomas constitute about 1 per cent of all gastric tumors, most of which are either spindle-celled myosarcomas or lymphosarcomas. In the intestines sarcomas are relatively much more common. According to Liu³ lymphoblastomas are the commonest tumors found in the small intestine, occurring three times as often as carcinomas. They may occur in any part of the intestine, but are most often found in the terminal portion of the ileum. They may be single or multiple. While rare in the appendix, Friend,⁴ in 1926, found nineteen cases reported and added one of his own.

Sarcomas of the gastro-intestinal tract may occur at any age, but are found most frequently between the ages of twenty-five and forty-five.

Rankin⁵ gives the sex occurrence as equal, but my own studies of the reported cases lead me to agree with Liu³ that males are afflicted twice as commonly as females.

* Read before the Section of Surgery of the New York Academy of Medicine, March 1, 1929.

Practically nothing is known regarding the etiology of these tumors. The theory of growth from embryonal cell groups has many supporters. Others feel that added to this there must be some exciting cause, such as tubercular infection. Certainly tuberculosis seems closely associated with sarcomas in many cases. Peterson⁶ in a compilation of eighty-five cases found three where the tumors occurred six to ten weeks after a severe contusion of the region.

The symptoms presented by sarcoma of the stomach are those presented by any other tumor and vary with the size and location. As a rule gastric dilatation is not so marked as in carcinoma, and the tumor is apt to be larger and therefore more easily palpable.

In sarcoma of the intestines the one practically constant symptom is pain, generally of a colicky nature, occurring as a rule throughout the middle of the abdomen and not affected by eating. There may be slight loss of weight and slight fever. Vomiting is not a prominent symptom as a rule. There may be a history of increasing constipation. While narrowing of the intestinal lumen is a common finding, Libman⁷ in 1900 could find no case of complete stenosis reported and I have found none since. Obstruction may be caused by intussusception which occurs not infrequently. Next to pain the most common finding is the presence of a palpable tumor increasing fairly rapidly in size. In some cases this is the only complaint the patient has.

The diagnosis is very difficult. Presence of a palpable tumor taken in conjunction with roentgenological findings of a partial stenosis, and occurring in a young patient, may at times make it possible, but not as a general rule. A good proportion of these patients come to the surgeon with symptoms of an acute abdomen and the correct diagnosis is only made at operation.

The duration of the disease is variable. Here it is that a uniform nomenclature and more accurate microscopic diagnosis in reported cases would help to clarify our ideas. Fisher⁸ makes the statement that most patients suffering from intestinal sarcoma die within nine months. This is a shorter period than given by most writers, the average being about eighteen months.

The prognosis is also variable and depends on the type of sarcoma and also the kind and time of treatment. Farr⁹ says the outlook in sarcoma of the stomach is no worse than in carcinoma, while Graves¹⁰ speaking of sarcoma of the intestines says "Death is the usual outcome." Some few cures have been reported. Kapel¹¹ reported one of fifteen and another of nine years' duration. One of our cases is alive and well eight years after operation.

There is some difference of opinion regarding the proper treatment of this condition. We must remember that no one man or clinic group has had a sufficiently long series of cases upon which to base their opinions—so that both the quoted opinions of others and our own conclusions are subject to change by future experience.

Considering the treatment the cases naturally fall into two groups. First is the very small group where the diagnosis can be made before operation and where the tumor is apparently resectable. Should these cases be submitted to the relatively dangerous operation of resection (Kapel¹¹ in his

report of resection in sixty cases of sarcoma of the stomach gives an operative mortality of 18 per cent), or should they be given deep X-ray therapy, which apparently is so efficacious, temporarily at least, in causing similar tumors in other locations to disappear? Crumston¹² in his article on sarcoma of the stomach gives the treatment as excision. Minot and Isaacs¹ in reporting a case of lymphosarcoma of the small intestine which lived seven years without recurrence and then died two years later, say that no case of that type has lived so long except following surgical removal. They favor surgery and radiation, though they go on to say "Radiation does not influence importantly the duration, it alleviates symptoms, decreases size of lesions and promotes patient's efficiency." Holmes, Dunn and Camp¹⁵ in their article on lymphoblastoma of the stomach say "The localized type of this disease should respond well to irradiation therapy or to a combination of irradiation and surgery." Rankin,⁵ while saying that treatment is unsatisfactory, thinks surgery seems to offer the best chance and adds that radium may give good results. Desjardins and Ford¹⁴ say that radiation may or may not cause definite prolongation of life, but it may keep the disease under complete or partial control for varying periods. Soiland¹⁵ is rather pessimistic regarding X-ray treatment. He says "It appears that we may successfully destroy the altered lymph nodes in every other part of the anatomy, even including those of the mediastinum, but we find our Nemesis in the abdominal cavity."

In the larger group of cases where diagnosis is only made at operation, there seems to be practically a unanimity of opinion that resection should be performed if possible, later writers favoring post-operative X-ray treatment.

In our experience resection, when possible, is still the method of treatment and we feel rather skeptical regarding the value of radiation. Even though incomplete, resection will often greatly prolong the life of the patient. In one of our cases (Case VII) the operator had to cut through tumor tissue in the mesentery of the intestine and yet this patient was well for nearly three and one-half years and had no X-ray treatment. In Case XIII where radiation alone seems to have caused a cure, the diagnosis was never proven and a later review of the patient would seem to show that the condition was tuberculosis of the peritoneum rather than sarcoma.

Resection should be performed whenever possible and may be followed by radiation if deemed advisable. If, however, radiation causes unfavorable symptoms such as vomiting or gastro-intestinal upsets we consider radiation of such doubtful benefit that we do not hesitate to discontinue it.

The use of arsenic should be mentioned. The present status of this drug is well summed up by Desjardins¹⁴ "Arsenic was used and when large doses were given over a prolonged period did result in transient improvement. However, results were not altogether satisfactory and these drugs are now seldom employed."

A brief summary of our cases follows (The first six cases were explored only, no attempt at complete resection being made.)

CASE I—Male, thirty years of age Pain in lower right quadrant, one hour after eating, for three months Vomited frequently Operation showed numerous masses in the small intestine with involvement of retroperitoneal nodes Specimen showed lymphosarcoma Died five months after operation

CASE II—Female, seven years of age Symptoms of acute abdomen, tuberculous peritonitis being the first choice Operation showed intussusception of small intestine caused by prolapse of a tumor the size of a walnut Enteroanastomosis without resection of tumor Twenty-six days later a foot of the intestine with the growth resected Several similar masses were found throughout the intestine Pathological report—lymphosarcoma Died six weeks after second operation

CASE III—Male, thirty-two years of age Pain of seven months' duration, extending from symphysis to umbilicus Operation revealed a tumor of ileum thirty centimetres from ilioæcal valve, with similar tumors in other portions of the ileum Enlargement of lymph nodes Pathological report—lymphosarcoma Died two and one-half years after operation

CASE IV—Male, thirty-seven years of age Discomfort and cramps across upper abdomen for one month Swelling of feet and distention of abdomen Operation showed huge tumor mass in retroperitoneal tissues, with metastatic nodes in meso of small bowel and one large tumor in the ileum, probably metastatic Pathological report—lymphosarcoma Died one month after operation

CASE V—Male, thirty-three years of age Pain in epigastrium, right upper quadrant and occasionally right lower quadrant for four months Vomiting at irregular intervals for six weeks Slight loss of weight Operation—diffuse infiltration of the small intestine encroaching on the lumen and extending into the meso at several points One mass the size of a fist Unquestionably lymphosarcoma Pathological report—material lost in process of embedding Died four months after discharge

CASE VI—Male, sixty years of age Pain in lower abdomen especially on left side for three months Lost a little weight Operation showed a large mass involving large intestine and ileum adherent in pelvis, non-resectable Pathological report—lymphosarcoma Died fifteenth post-operative day

CASE VII—Female, thirty-four years of age Pain around umbilicus for eight months Loss of weight and strength Palpable tumor in left side of abdomen Operation—mass ten centimetres by eight centimetres involving whole circumference of gut about five centimetres from duodenojejunal junction One large node in mesentery of gut Resection with end-to-end anastomosis Pathological report—lymphosarcoma Died three years seven months after operation

CASE VIII—Male, thirty-five years of age Epigastric pain for six months Thirty pounds loss of weight Increasing constipation Palpable tumor Operation—three separate tumors of small intestine contained in the first two feet of jejunum Resection with end-to-end anastomosis of jejunum and duodenum Pathological report—lymphosarcoma Unable to trace patient

CASE IX—Male, thirty-five years of age Symptoms of partial intestinal obstruction for five weeks X-rays showed obstruction in splenic colon Operation showed constricting mass at splenic flexure First stage Mikulicz and cæcostomy done Pathological report—lymphosarcoma Died suddenly day after operation

CASE X—Female, eighty-four years of age Tumor size of orange, constant in size, for five weeks, to right of umbilicus Increasing constipation Operation showed intussusception at ilioæcal valve caused by prolapse of tumor of ileum about four centimetres in diameter First stage Mikulicz operation done Pathological report—lymphosarcoma Died on fourth post-operative day

CASE XI—Male, twenty-four years of age Recurring pain in right lower quadrant for eighteen months Came to hospital with symptoms of acute appendicitis Operation—diffuse tumor involving entire circumference of terminal four inches of ileum Tri-

LYMPHOSARCOMA OF THE GASTRO-INTESTINAL TRACT

angular segment of enlarged nodes running beyond duodenum Resection of terminal ileum and ascending colon together with nodes, with side-to-side anastomosis Pathological report—lymphosarcoma Uneventful operative recovery Given deep X-ray therapy Well one year post-operatively

CASE XII—Male, thirty-four years of age Pain in epigastrium of six months' duration, coming on one day to one hour after eating Lost twenty pounds weight Operation—mass size of palm of hand in posterior surface of stomach with enlarged nodes Distal one-third of stomach resected Pathological report—lymphosarcoma In excellent health nine years later

CASE XIII—Male, thirty-seven years of age Severe pains about umbilicus for one month Lost a little weight Palpable mass in right side, deeply adherent X-ray showed general limitation of lumen of small intestine No operation as condition was deemed inoperable Diagnosis thought to be sarcoma, though a note was made that there is a possible tuberculous lesion at the apices, so the diagnosis may be tuberculosis of peritoneum No pathological report Tumor mass gradually disappeared under X-ray therapy Three and one-half years later was in excellent health

Two cases of myosarcoma have been operated

CASE I—Male, twenty-eight years of age Sudden sharp pain in epigastrium to left mid-line Thought to be perforated gastric ulcer Operation showed huge tumor on anterior wall of stomach which perforated at operation Resection done Pathological report—myosarcoma Given X-ray therapy, but died eighteen months later

CASE II—Female, twenty-eight years of age Always constipated Nausea and cramps in abdomen for two weeks Operation—intussusception due to prolapse of tumor of cæcum Intussusception reduced and tumor which did not appear grossly malignant, with surrounding cæcal wall, resected Pathological report—myosarcoma of local malignancy type Excellent health ten and one-half years later

RECAPITULATION

There were thirteen cases of lymphosarcoma, all but two proven by microscopical examination, one not operated and one where the material was lost Ten were males, three were females Ages range from seven to eighty-four, average thirty-five Ten cases involved small intestine, two large intestine, and one stomach

Twelve cases were followed, one being lost track of Seven died within one year, one died at the end of two and one-half years, one died after three and one-half years, one not operated, so diagnosis not proven, is well three and one-half years later, one resected, is well one year later, one, stomach resected, is well nine years later

SUMMARY

1 A uniform nomenclature and more careful microscopical diagnosis are needed to enlarge our knowledge of this condition

2 Treatment is unsatisfactory Resection when possible followed by X-ray therapy, seems to offer greatest chances for a cure

I desire to express my appreciation to Dr Charles L Gibson for permission to publish these cases, all of which were operated on in his service at the New York Hospital

Since this paper was written we have had another case of lymphosarcoma of the ileum which I feel deserves inclusion in that we were able to make a diagnosis from the history before operation

A man of thirty-five years, who was operated upon five months previously for chronic appendicitis now complained of pain to the right of the umbilicus coming on about two hours after meals with the sensation of the formation of a mass which could be palpated at times. After a few minutes this pain would disappear and there would be a feeling of the letting up of a constriction and the passage through of liquid could be either felt or heard or both

From this rather typical history the diagnosis of lymphosarcoma was made. X-rays gave the impressions of adhesions in the region of the cæcum. Operation revealed extensive lymphosarcoma of the ileum with involvement of the lymph nodes of the mesentery. Twenty cubic centimetres of ileum were removed with end-to-end anastomosis.

Pathological report was lymphosarcoma. The patient is still in the hospital, although he has made an uneventful recovery and is to receive X-ray treatment.

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THE POST-OPERATIVE COMPLICATIONS OF CHOLECYSTECTOMY

A STUDY OF 700 CHOLECYSTECTOMIES *

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IN THIS report I shall limit the discussion to the study of the post-operative complications encountered in seven hundred consecutive cholecystectomies in the Henry Ford Hospital. These complications are perhaps fewer and simpler than they would be if we were to include our cases of cholecystostomy and also choledochotomy, when not done in association with cholecystectomy, and those cases where malignancy was present. In a later paper, however, we are contrasting the two groups in the types and frequency of unfavorable sequelæ.

No operations on the gall-bladder, except in acute cases, are done in our clinic without a thorough work-up, including studies of biliary drainage and cholecystography. The latter has proven of great value, though it is not yet infallible. Especial attention is paid in jaundiced cases to bleeding and coagulation times, in all cases in which this is prolonged beyond the normal of three and five minutes, calcium lactate (2 per cent solution in fifty cubic centimetre amounts) is given intravenously. It is our custom to give this twice a day until the bleeding and coagulation times approach normal. In a series of 145 cases in which cholecystography was done, 111 gave positive findings (non-filling, delayed emptying, or stone shadows), and fifteen gave questionable findings. In this series of 126 "positives", ninety, or 71 per cent, showed stones at operation. Nineteen of the 145 cases gave negative results by cholecystography.

The gall-bladder is not removed unless it shows, on direct inspection and palpation, some sign of disease, such as adhesions, thickened walls, scarring of liver capsule around it, or stones in the gall-bladder or ducts. I am still in doubt, however, as to whether the gall-bladder should be removed where there is no shadow of the dye in the gall-bladder films and yet direct examination shows an apparently normal structure. I have decided against removal of such a gall-bladder, and later thought it should have been excised. On the other hand, we have removed the gall-bladder in nineteen cases where there were normal cholecystograms, but some positive findings of previous disease. As the results have not been entirely satisfactory in these cases, we believe that a normal cholecystogram probably means normal gall-bladder physiology.

To study accurately post-operative complications one should understand

* Read before the Southern Surgical Association, December 12, 1928

thoroughly the pre-operative condition and the treatment used, and should know also the operative findings and procedures. For this reason I am giving a brief outline of the routine in this series of cases.

To have the patient in as nearly normal physical condition as possible no cathartics are used. The abdomen is shaved before the patient goes to the operating room. A soapsuds enema is given the morning of operation and $1/6$ grain of morphine and $1/150$ grain of atropine are given a few minutes before the patient leaves the floor. When it can be arranged, the patient enters the hospital twenty-four hours or more before operation to avoid, as far as possible, newly acquired respiratory infections. Ethylene gas, often with an ounce or two of ether, is administered by professional nurse anesthetists. The operating table is inclined with the foot one to two feet lower than the head.

After cleaning up with tincture of iodine and alcohol an upper right rectus incision is made, beginning a little to the right of the mid-line and extending to two fingers' breadths below the umbilicus. After incision is made through the anterior sheath of the rectus the entire muscle is retracted outward, and incision is continued through the posterior sheath and the peritoneum. Moynihan¹ refers to this incision as having been first used by Hartmann and Kocher, and it has recently been described by Graham². It gives an excellent exposure, prevents injury to the rectus muscle nerve supply, and is less likely to be followed by hernia.

Our procedure is to strip the gall-bladder from the liver, starting at the fundus, though in a small number of cases in this series the cystic vessels and duct were first clamped and divided and the dissection carried on from there outward. The cystic artery is tied separately with No. 1 chromic catgut. The cystic duct stump is cauterized with carbolic acid, washed off with 70 per cent alcohol, transfixed, and ligated with fine chromic. In this series all cases were drained to the cystic duct stump with a small cigarette drain with smooth rubber surface, the drain being entirely removed on the fifth or sixth day after operation. In only one case have I ever made closure without drainage following cholecystectomy, and that was in 1914, early in my career as Resident Surgeon at the Johns Hopkins Hospital. There was a well-remembered conversation the following day with Dr. William Stewart Halsted, the professor, and I have never had the heart to repeat the procedure, though we did have a 100 per cent recovery without any complications in that little series of one.

Only occasionally do we suture the peritoneum over the raw bed left where the gall-bladder is stripped from the liver. The omentum is brought up and placed against this area and around the drain as completely as its volume allows. The peritoneum and posterior sheath of the rectus are closed with continuous plain No. 1 catgut. Three or four silkworm-gut sutures are placed down through the anterior sheath, a small portion of muscle, and back through the skin. The anterior sheath is closed with figure-of-eight chromic No. 2, the subcutaneous with plain catgut interrupted. The skin is closed

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with interrupted fine silk sutures Silver foil is placed along the incision, gauze pads are used as dressing, and the wound is strapped securely with adhesive extending well around to the back on each side, care being taken to avoid undue compression of the lower chest and obstruction of thoracic breathing efforts

When the patient is returned to his room, he is usually conscious or nearly so If the pain becomes bothersome, pantopon in doses of $\frac{1}{2}$ to $\frac{1}{4}$ grain is used every four hours the first day Water is given by mouth early, unless contraindicated by nausea It is given also by rectum, vein, or by hypodermoclysis The patient is turned frequently (*ie*, every half-hour) from side to side, and within a few hours a partial sitting position is possible by the easy adjustments of the Ford Hospital bed, which has proven so popular with manufacturers and is now seen in most hospitals It is a Gatch³ bed, modified by worm-gear elevating and lowering devices

The drain is entirely out on the fifth or sixth day, and the silk and silk-worm sutures are removed on the tenth day The average patient is ambulatory in two weeks and is discharged as soon as his strength permits, normally on the sixteenth day We encourage exercises as described by Dr Eugene Pool⁴ and prescribe massage wherever it can be afforded

Transfusion of blood is used freely and with little more indication than is asked for intravenous infusion of physiological salt solution, and I believe that it has prevented shock and hæmorrhage in many cases, especially those complicated by jaundice Indirect transfusion is used almost entirely

Before introducing the material on post-operative complications we will present certain facts in regard to the previous surgical history of the seven hundred cases, the extent of the operative work done on these patients in our clinic, and the reports from our pathological laboratories

TABLE I
History of Previous Operation

	Cases
Tonsillectomy	110
Appendectomy	91
Biliary tract operations	29
Hysterectomy	28
Salpingo-oophorectomy	27
Other gynæcological operations	27
Laparotomy	12
Rectal operations	12
Nasal operations	10
Kidney operations	8
Herniotomy	7
Amputations	4
Gastro-enterostomy	3
Removal of bone tumor	1
Removal of coccyx	1

Twenty-nine, or 4.014 per cent, of our 700 cases of cholecystectomy in this series had had previous biliary tract operations elsewhere, 297, or 41

per cent, had had a total of 370 previous operations on other parts of the body One would surmise from the study of this chart that many of them had an acute or chronic infection which might very well have etiological significance in connection with the cholecystitis It is also probable that some of the appendectomies were done at a time when the gall-bladder condition was already primary.

TABLE II
Operations Associated with Cholecystectomy

	Cases	
Operations on common duct	86	..i
Operations on cystic duct	44	..t
Appendectomy	435	
Release of adhesions	60	
Operations on tubes and ovaries	41	
Perineal repair	28	
Hysterectomy	23	
Suspension of uterus	18	
Gastro-enterostomy	10	
Enteroplasty	6	
Drainage of gall-bladder abscess	4	

In 496, or 70.8 per cent, of the 700 cases we did work beyond a simple cholecystectomy at the time of operation which represents a total of 755 operations on the 496 cases Four hundred and thirty-five, or 62 per cent, had appendectomy done at the same time The frequent association of chronic appendicitis and cholecystitis rather suggests that appendicitis is often the forerunner of cholecystitis I have seen two cases where there was an acute cholecystitis associated with acute appendicitis, only one of them, however, in this series I will speak further of the effect of multiple operations on our mortality rate, especially where another incision at the one session was required

TABLE III
Pathological Diagnosis

Cholelithiasis	386
Cholecystitis, chronic	595
Catarrhal cholecystitis	65
Strawberry gall-bladder	16
Calcified gall-bladder	2
Papillomatous gall-bladder	1
Normal gall-bladder	2
Cholecystitis, acute or subacute	105
Acute exacerbation of chronic	25
Gangrenous gall-bladder	13
Perforated gangrenous	8

Table III is made up from the report of our pathologist Dr Frank W Hartman, of examinations carried on at the time of removal of the gall-bladder and studies of microscopical sections of the gall-bladder wall

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TABLE IV

Post-operative Complications Peculiar to Gall-bladder Operations

546 cases 1916-1926		154 cases 1927-1928	
Post-operative hæmorrhage	4	1	
Secondary closure wound	6	1	
Pneumothorax	1	0	
Hernia in operative scar	1	1	
Persisting biliary fistula	2	2	105 days in hospital
Pancreatitis	4	0	84 days in hospital

Wound completely healed * 30 days post-operative, 146 days post-operative

We now arrive at the statistical data which prompted this discussion, namely, the post-operative complications. I am showing two tables—first one, No. 4, giving the complications more or less peculiar to gall-bladder operations. For the sake of comparison we have drawn a line of division in our series at the end of the year 1926, including in the first group those cases recorded from the opening of the Henry Ford Hospital in 1916 to December 31, 1926† and in the second group the cases recorded after January 1, 1927.

This table shows five post-operative hæmorrhages, of which two were fatal. One came on three weeks after operation from the cystic or, possibly, the hepatic artery in a patient who had had stones in the hepatic ducts as well as in the gall-bladder. The patient died of acute hæmorrhage before an operation could be done. The other patient died on the eighth day, following the breaking open of the wound and hæmorrhage. Myocarditis was a complicating factor in the second case.

The number of cases necessitating secondary closure of the wound—in spite of figure-of-eight chromic catgut, silkworm gut and firm binding—may seem rather high. Our custom has been to bring the drain through the upper end of the primary incision. If the experience reported in the literature could be summarized, we would soon know whether a separate stab incision outside of the rectus or in the flank is the better way. Only one patient died in this group of seven after secondary closure of the wound, a case in which the second closure was made on the eighth post-operative day with through-and-through interrupted silver wire, as is our usual custom.

So small a percentage of post-operative hernia speaks well for the type of incision above described. On the other hand it may prove to be too low an estimate when we have finished the recalling process which is now under way. Our patients are kept in bed twelve to sixteen days, so that wounds have healed solidly before discharge from the hospital.

The number of persisting biliary fistulæ is small as this paper does not include cancer cases or operations on the strictures of the common duct, unless associated with cholecystectomy. Under "wound completely healed",

* Average includes choledochotomy.

† It should be noted that one year, 1918-1919, our clinic was closed and the entire surgical staff was with the United States Army in France. The Hospital buildings were turned over to the Government by Mr. Henry Ford.

the average period seems a long one, but this includes the cases of common-duct drainage. In the earlier years it was our practice to insert several drains instead of the present single, small, smooth, cigarette drain. Then, too, by "wound healed", is meant the complete closing over with epithelium.

TABLE V
Post-operative Complications

	1916-1928 No of cases	Per cent	1927-1928 No of cases	Per cent	Total No of cases
Wound infection	22	40	3	20	25
Bronchopneumonia	8	14	1	65	9
Lobar pneumonia	3	6	0		3
Pleurisy with effusion	2	36	3	20	5
Massive collapse of lung	0		1	65	1
Pulmonary embolus (infarct)	2	36	4	26	6
Myocarditis fibrillation (angina pectoris)	7	128	2	13	9
Phlebitis	6	12	1	65	7
Pyelitis—cystitis	5	9	3	20	8
Peritonitis (general)	1	18	1	65	2
Paralytic ileus	0		1	65	1
Thrombosis (femoral vein)	2	36	0		2
Thrombosis (iliac and vena cava)	0		1	65	1
Total					

In the second table, No. V, by "wound infection" we mean stitch abscess or some sign of pyogenic infection. I am sure we would have a higher percentage if we took routine cultures, especially in cases where there is drainage of bile and we have positive cultures from the gall-bladder. Drainage of bile has not been included on this chart as a post-operative complication, and yet probably should be regarded as such, except where the common duct is drained. Because of the careful ligating of the cystic duct, such drainage is not to be expected, and we are convinced that in at least the majority of cases it comes from an accessory bile duct and less frequently from damaged bile ducts on the raw liver surface.

In the earlier years nitrous oxide gas and ether were used as the anæsthetic, as contrasted with ethylene gas and less ether during the last five years. Immediate post-operative discomfort and possibly respiratory complications have been less as the result. The number of cases with phlebitis seems rather low in this table, especially in the second column which shows three cases of pulmonary embolus, certainly the phlebitis was not where it could be located clinically. The thrombosis and embolism cases continue to be our *bête noire*.

The low rate for peritonitis cannot be said to argue against the much smaller amount of drainage left in the wound in contrast to the much larger amount of fifteen years ago.

From the literature we cannot get accurate knowledge of the amount of paralytic ileus of fifteen and twenty years ago, but it is my impression that it is now much less frequent than formerly. Experience shows that post-

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operative distention is not the frequent problem that it used to be, since the use of strong cathartics as a pre-operative measure has been discontinued, and that paralytic ileus is now occurring in a much smaller per cent of cases

TABLE VI

Deaths

Cause of Death	1916-1920 Cases	1921-1922 Cases	1923-1924 Cases	1925-1926 Cases	1927-1928 Cases	Total Cases
Primary hæmorrhage	1			1		2
Pulmonary embolus	1		1		3	5
Bronchopneumonia		1	4	1	1+shock	7
Myocardial failure		1	5	3		9
Acute hæmorrhage pancreatitis	1					1
General peritonitis			1		1	2
Pyloric obstruction	1					1
Acute gastric dilatation				1		1
Gall-stone in common duct				1		1
Multiple liver abscess					1	1
Pyonephrosis—Thrombosis iliac veins and Vena cava					1	1
Total number of deaths	4	1	11	7	7	31
Total number of operations	32	80	257	177	154	700

This table, showing the cause of death, is striking in that shock has not been placed as the cause of death in a single case. Undoubtedly it did play a considerable part in the cases where death occurred after operation. However, the free use of transfusions of blood in prolonged cases, poor risks, and wherever there is jaundice or anæmia, undoubtedly is a tremendous aid in preventing the onset of shock. The careful typing of blood in preparation for transfusion is a part of the pre-operative routine.

As there were only two deaths from primary hæmorrhage, neither of whom had jaundice, and no deaths from secondary hæmorrhage, jaundice with prolonged bleeding time appears to be no longer a bugbear, but to have been successfully combated with calcium lactate and transfusions of blood.

I feel that a gall-bladder operation should never be done as an after-thought secondary to a pelvic or other operation unless the condition is very acute. In our series three cases died where the gall-bladder was found diseased and to contain stones, whereas an operation in the lower abdomen was scheduled as the primary operation. A second incision was made on completion of the primary operation and the gall-bladder removed. In another case in which a pyloric obstruction was found at the time when cholecystectomy was done, a gastro-enterostomy followed the primary operation. This patient died three days after the operation. Whenever possible we now make it a point to wait seven to ten days before doing the second operation, and our results have justified this precaution.

Summary—Of our seven hundred operations we have here charted 102 with complications, the most frequent and least serious being the wound infections which occurred in 35 per cent of the cases. There were no deaths. Pneumonia in twelve cases, or 17 per cent, with nine deaths, makes

pneumonia the most serious of the complications Myocardial failure ranks second with nine deaths Pulmonary embolus was recognized in six cases, with five deaths

CONCLUSIONS

We believe that the incidence of pneumonia as a post-operative complication can be further reduced by sufficient immediate pre-operative dental prophylaxis treatments and by having the patients in the hospital a day or two before operation to preclude the danger of acute respiratory infection from outside contact

The number of myocardial deaths can be further reduced by closer cooperation with competent clinicians, who now must give assurance that any case with any myocarditis or other heart lesion has been brought by them to the optimum time for the operation as far as that individual heart is concerned

The percentage of thrombosis and embolism cases is more difficult to reduce as the etiology is not so clear Post-operative exercises as recommended by Pool, and thyroid medication as recommended by Walters may be of benefit An anti-coagulant injected at the time of operation may offer the best solution

Four of our deaths were in patients who had a second incision made for removal of the gall-bladder when the primary operation was a pelvic or lower abdominal one The practice of performing a second operation under the same anæsthesia increases the mortality rate

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CARCINOID TUMORS OF THE APPENDIX

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DURING the past thirty years numerous reports, largely from a pathological and etiological viewpoint, have been made of tumors of the small intestine and particularly of the vermiform appendix, which bear a close resemblance to carcinomata, and which have frequently been considered malignant. From the clinical and histological evidence at present these tumors must be considered benign in character. Originally described as carcinoma, they have been, since 1907, reported usually as carcinoids or argentaffin tumors.

These tumors have commonly been found in young adults, usually before the age of twenty-five, or have been discovered at autopsy in those dying of some unrelated condition.

The recent change in the viewpoint of pathologists regarding the origin of these tumors of the appendix is of considerable interest and importance, and for this reason it seems proper to place on record further cases which may not only be of interest but may bring to mind the importance of differentiating these tumors from malignant conditions. This report is based on a recent case together with a study of seven cases other than my own.

True cylindrical-cell adenocarcinomata may occur in the small intestine and in the appendix but as compared with frequency in other parts of the gastro-intestinal tract, they are very rare. Carcinoma in the intestinal tract in young adults is characterized by rapid growth and early metastases, and must be given a poor or doubtful prognosis. In carcinoma of the appendix and ileocaecal region, attempts at wide resection of the involved and adjacent tissues have been considered the only safe procedure, usually to be followed by intensive deep X-ray therapy.

It may be quite important from the patient's standpoint that an extensive resection be done if the condition is malignant. It may be of almost equal importance to the patient that no extensive operative procedure be carried out if the growth is benign in character.

In view of our present knowledge carcinoid tumors may be considered, from the therapeutic standpoint, in a similar relation to carcinoma, as giant-cell tumor is related to osteogenic sarcoma. Not many years ago giant-cell tumor was treated by amputation or by extensive resections of the involved tissues. Today it is recognized that such radical procedures are unnecessary, and that removal of the tumor tissue only is necessary.

It is, therefore, of utmost importance that a benign carcinoid be differentiated from malignant tumors of the appendix if the patient is to receive the proper treatment. Because of the extensive adoption of the operating room microscopic examination either by frozen sections or by unfrozen sections

stained with polychrome methylene-blue solution, it is of extreme importance that a correct microscopic diagnosis be made so that the correct surgical procedures may be carried out. Even today experienced pathologists may easily mistake carcinoid for carcinoma unless the former is kept in mind. The occurrence of a tumor without evidence of metastases in a young individual, in the teens or early twenties, should call for an unusually careful examination by the pathologist.

The following illustrates a rather typical case of carcinoid of the appendix.

A boy, seventeen years of age, was admitted to the United States Marine Hospital, Baltimore, Md., October 28, 1928, complaining of abdominal pain. He stated that two days previously he began having cramp-like pains in the abdomen. These pains continued quite severely for a time over the abdomen and then became localized in the

right lower quadrant of the abdomen. Although pain has now almost disappeared he still has some discomfort and tenderness in the right lower quadrant of the abdomen. The patient states that this is only one of several similar attacks which he has been having at intervals during the past five years. The history was otherwise essentially negative. Physical examination revealed no abnormal findings worthy of note except in the abdomen. There was no involuntary rigidity of the abdomen over the region of the abdomen. No definite palpable masses could be found, but tenderness on palpation was complained of in the region of



FIG. 1.—Carcinoid tumor of the appendix, located at tip of the appendix producing bulbous enlargement. The peritoneum over the tumor appeared unchanged.

the appendix. The temperature on admission was 97.8° F. The pulse was 85. The leucocyte count was within normal limits. An X-ray examination of the right kidney and ureter was made in an effort to rule out the possibility of pathology in the urinary tract. This examination revealed no abnormality. It was thought that the patient had a subsiding appendicitis. Because of the history of repeated attacks of pain in the right lower quadrant of the abdomen together with the fact that the patient was a seaman who frequently would be out of reach of medical attention for several days at a time, he was advised to have his appendix removed. At operation the appendix was found somewhat tortuous, and its tip was a bulbous enlargement (Fig. 1). The peritoneum over this bulbous swelling was as normal in appearance as the remainder of the appendix. No glandular involvement nor other tumor masses could be found. The usual appendectomy was done. Upon sectioning the appendix the end was found to be composed of rather firm tumor mass. The lumen was intact, although smaller than the remainder of the lumen proximal to the tumor. The muscularis and peritoneal covering did not appear to be invaded. Sections showed a typical carcinoid or argentaffin tumor with evidence of associated chronic appendicitis.

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The etiological and pathological aspects of carcinoid tumors have been adequately described by Masson, Foibus and others, so that no detailed discussion seems warranted. Briefly, however, the etiology may be summed up according to our present knowledge as follows. Carcinoid cells result from proliferation of the intranervous argentaffin cells of the neurocrine type. The intranervous argentaffin cells originate from the epithelium of the glands of Lieberkuhn. These cells proliferating in the connective tissue assume the characteristic appearance of neurocrine cells. Carcinoids are, therefore, tumors of the chromaffin system. Due to the fact that the granules of certain cells have the ability to reduce ammoniacal solutions of silver, the name argentaffin has been given to this type of tumor. The gross pathology may not be pronounced. The appendix may appear quite normal except for the dilated bulbous end. If the carcinoid is small it may be overlooked entirely, and the changes present may be attributed to the changes of chronic appendicitis if microscopic sections are not made. On splitting open



FIG 2—Carcinoid tumor of the appendix. Section of carcinoid tumor showing tumor mass in the submucosa, but also involving the mucosa. (Low magnification)



FIG 3—Typical arrangement of the cells in carcinoid tumor of the appendix. Epithelial cells arranged in masses in a network of fibrous stroma.

an appendix with a carcinoid at its tip, it is noticed that the lumen is small or may be completely obliterated and replaced by this hard fibrous, compact tissue forming the tumor.

Microscopically (Figs 2, 3 and 4) the tumor is found to consist of epithelial cells grouped in columns of various size, with a fibrous struma. The predominating cells are oval or round. Some low columnar cells may be seen, and the shape of the cells seems to be largely determined by their location and their relation to the supporting struma. The predominating round cells have their nuclei centrally placed, and the protoplasm may be dotted with acidophile granules. In other cells the cytoplasm contains no granules, but on the other hand may be vacuolated. These cells are found arranged in masses embedded in an eosin staining stroma. This stroma is composed of hyaline connective tissue, a moderate number of blood vessels and a few small lymph spaces, with here and there nerve bundles. The tumor nodule itself may be said to lie in the mucosa and submucosa. The mucosa may be infiltrated with tumor cells, while the muscular layers may show little infiltration. While the invading tumor may involve the muscularis, the peritoneum seems to remain intact.

If any doubt exist as to the true nature of these tumors one may call to his aid the more complicated process of silver impregnation, and may determine the true nature of the cells by the peculiar ability of the granules of the tumor cells to reduce an ammoniacal solution of silver.

In the cases studied, and those reported by others, a constant reliable basis for differential diagnosis may be formed from a study of the arrangement of the cells, the character of the cytoplasm, and the general relationship of the tumor to the intestinal wall.

The microscopic appearance, the small size of the tumor, the absence of metastases, together with its occurrence most frequently in young individuals before the cancer age, should make the diagnosis of carcinoid quite certain, and an assurance may be given the patient and his relatives that further trouble is very improbable.



FIG. 4.—Carcinoid tumor of the appendix. Oval and round cells arranged in masses embedded in an eosin staining stroma. In areas the masses of cells appear definitely circumscribed. In other areas the tumor cells may be seen infiltrating adjacent tissues.

It is doubtful if any symptoms may be attributed to the tumor itself unless situated along the body of the appendix, in which case obstruction to the lumen might give rise to an inflammatory reaction. Many of these tumors, previously reported, have been found at autopsy, and so far as the history was obtained there were no symptoms referred to the appendix during life. In those cases occurring in young adults, these appendiceal tumors were usually found at operation, in

which case they were frequently associated with an acute or chronically inflamed appendix. In fifty cases found in examining 1200 appendices reported by Masson, forty-six occurred in the tip of the appendix, only four occurring along the body of the appendix. Masson further noted that frequently the lumen was entirely obliterated, so that if any objective symptoms are caused by these tumors they are probably not caused by obstruction to the lumen in the great majority of cases.

SUMMARY

Attention should be called to the fact that the great majority of tumors of the vermiform appendix occurring before the age of twenty-five, will be found upon careful study to be carcinoid tumors rather than carcinoma.

Since experienced pathologists viewing well-stained sections may render a report of carcinoma, it is obvious that sections made in the operation room from frozen sections or from unfrozen sections, stained with polychrome methylene-blue, offer even greater chances for an incorrect pathological report, unless the possibility of this benign tumor is kept constantly in mind.

CARCINOID TUMORS OF THE APPENDIX

The correct pathological report is of paramount importance in the treatment of suspicious malignancy

The differentiation between carcinoid tumors and adenocarcinoma of the appendix, which are superficially very similar, is of the utmost importance. The differential diagnosis may be made by a study of the arrangement of the cells, the character of the cytoplasm, and the relationship of the tumor to the intestinal wall, together with the limited gross pathology, occurring in a patient in the teens or early adult life

Carcinoids or argentaffin tumors are, according to our present knowledge, benign in character. Therefore, no radical surgical procedures should be attempted, but only the usual appendectomy done

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ROUTINE REMOVAL OF THE APPENDIX IN RIGHT INGUINAL HERNIORRHAPHY

REPORT OF NINETY-SIX APPENDECTOMIES IN ONE HUNDRED
CONSECUTIVE OPERATIONS FOR HERNIA

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THE correlation of diseased or abnormal conditions of the appendix with hernia has been reported by a large number of investigators. The greater number of these have been concerned with the finding of acute appendicular pathology as a complication of hernia. The earliest record of the presence of the appendix in a hernial sac is cited by Deaver¹ as having been reported in the case of Claudious Amyard, Esq., who, in 1735, in the course of an operation upon a boy of eleven, traced a sinus in the thigh to an incarcerated scrotal hernia, wherein was found the appendix perforated by a pin. Morgagni² describes finding of the appendix in the hernial sac in the performance of dissection, Ewart³. The incidence of association of the appendix with the hernial sac has been variously estimated by more recent analyses.

Wood⁴ reported the presence of the appendix in fifty-eight of 3054 hernias of all types, irrespective of the presence of other viscera. Inguinal hernias were found to harbor the appendix more frequently than those of the femoral site.

Robinson,⁵ in a series of autopsies, found that in approximately one third of 435 instances the cæcum (and appendix) were in "potential position" to enter the dependent peritoneum of inguinal hernias.

Coley⁶ encountered the appendix in the sac of less than 5 per cent of inguinal hernias subjected to operation, while Kelly⁷ expressed the belief that the appendix was a component of 2 per cent of all hernias, irrespective of variety and location.

Kelly and Hurdon, in 1909, collected two hundred cases in which the appendix appeared in the situations under discussion, the finding of 75 per cent being identified with inguinal rupture.

Rivet⁸ reported 63 per cent inguinal and 30 per cent femoral in ninety-four cases of appendicular hernia.

Etiology—These writers ascribe to Rokitsansky, Virchow and Orth the congenital theory of appendicular implication—that anomalous development, investiture or inflammation of the fetal peritoneum, is the cause alike of hernial protrusions and appendicular participation. Carnett,⁹ in an independent investigation, confirmed this theory, which had been ascribed by Jopson¹⁰ to Wrisberg and Lockwood. Hutchison¹¹ was of the opinion that disease of the appendix might be the exciting cause of hernia—a theory which has attracted little support and no further exemplification. He detailed the occurrence of acute appendicitis following herniotomy, as did Alexander¹². Unquestionably, abdominal rigidity or distention associated with peritonitis of appendicular origin may introduce viscera into a hitherto unoccupied hernial sac, and induce incarceration or even strangulation (Davis and Peon¹³). Other writers have been concerned with the existence of acute appendicular infection as a component of hernia (supplementary bibliography).

Purpose of Investigation—Two considerations prompted the present operative inquiry. They were (a) determination of the incidence and extent

of appendical pathology in right inguinal hernia, and (b) the practicability of routine removal of the appendix through the usual herniotomy incision. With these objectives, one hundred consecutive right inguinal hernias were operated upon in the Santo Tomas Hospital, Panama, through the courtesy of the chief of surgical staff, Dr A. S. Boyd, and these included twenty-eight bilateral, eleven irreducible, and three strangulated hernias. Of the one hundred cases, ninety-six were subjected to appendectomy through a hernia incision of ordinary size, and, of these, fifty-one operations were completed by ingress through the sac, and forty-five by a supplementary opening of the peritoneum which will later be described under "Technic." Of the four cases in which appendectomy was not done, one was of strangulation and three of abnormally high cæcum. The completed cases comprised eight in which delivery of the appendix was difficult, and of these, four demanded a degree of technical application which overshadowed the possible benefit to be conferred. In one instance it was necessary to leave *in situ* 15 centimetres of the tip of a retrocæcally situated appendix, with sequelæ of pain and fever. There were eight post-operative infections, six of class A, and two of class B. No other local complications were encountered. Stovaine (Billon) was employed intraspinally in nine-three cases, ether was used five times, and novocaine locally twice. Three patients suffered post-operative bronchopneumonia.

Two deaths marred the clinical aspect of the series. One was due to the late effects of secondary hæmorrhage from a needle wound of the left deep epigastric vein, incurred during a simultaneous left inguinal herniorrhaphy at the hands of an assistant, and the second resulted from unsuspected chronic ulcerative colitis.

Pathology—Doubts concerning the value of this sometimes difficult procedure were definitely dispelled by the pathological findings. No less than eleven instances of sliding hernia of the cæcum, appendix, or both, were encountered. This relatively high percentage can be understood by bearing in mind the large size of hernias in communities in which surgical correction is for many years postponed or habitually avoided. The appendix was found free in the sac contents in six cases, in one case—that of strangulation—acutely inflamed. Grossly diseased appendices (including the adherent) were removed on eleven occasions. Development anomalies totalled twenty-six, and of these, nine presented adhesions or membranes of development type, eight were of abnormally high cæcum or appendix, five were retrocæcal in situation, and four were of redundant cæcum. Two appendices harbored *Endamæba histolytica*, and one, an encysted cherry seed. With the inclusion of three cases in which the cæcum was too high to be presented in the operative zone, these abnormalities totalled sixty. From a pathological viewpoint it is seen that the conditions justified performing the appendectomies in addition to the herniorrhaphies, in spite of the additional difficulties involved. The only analogous investigation on record—that of Sheldon¹⁴—

yielded eight diseased appendices out of twelve removed, a pathological percentage almost identical with that of the present series

Technic—The manœuvre employed to gain access to an appendix not readily delivered in the saccular peritoneum was used and described by F Torek¹⁵. This consists, in effect, of a supplementary muscle-splitting approach to the peritoneum in the upper angle of the hernia incision. It was Torek's practice, however, to extend upward the skin incision, and to remove the appendix before performing reconstruction in the inguinal canal. Harrigan¹⁶ and Coley¹⁷ made use of this technic. These surgeons have not attempted the routine removal of the appendix in such cases nor estimated the frequency of appendicular involvement. The present writer has found it unnecessary to enlarge the skin aperture, the normal looseness of the tegument in the iliac region permitting adequate retraction. A desire to minimize the risk of infection dictated complete suturing of the conjoined tendon and arching fibres of the internal oblique and transversalis muscles to Poupart's ligament, before performing appendectomy. Simplification of the technic and acceleration of closure have been obtained by the use of a single strand of No 1 iodine catgut for peritoneum, transversalis fascia, the muscles, and external oblique aponeurosis, locking the suture at the completion of each step.

Although periodic examination of the patients in this series was impracticable, it was well established that most recurrent hernias were accustomed to return to the hospital for the reason that no other medical service was available. There were no recurrences known to the operator one year after completion of the series.

CONCLUSIONS

1 Abnormalities of the appendix, justifying its removal, are present in the majority of individuals with right inguinal hernia.

2 The appendix can be safely removed through the usual herniotomy incision, in a high percentage of cases. Since the addition of this step does not add appreciably to the operative risk, nor jeopardize the effectiveness of hernia repair, routine appendectomy is considered desirable.

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EMULSIFIED CAMPIODOL AS A PYELOGRAPHIC MEDIUM*

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THE use of satisfactory shadow-casting media for Rontgen-ray mapping of the cavities and tracts of the body has become of salient importance in the armamentarium of the modern medical man. New substances and new technic for the improvement of this diagnostic method are always to be desired, and it is for this purpose that we wish to record our preliminary experiences with an emulsion of a new iodized oil, campiodol (Frazier and Glaser), applied for the first time as a pyelographic medium¹

Barium and bismuth meals introduced by Klose for examination of the alimentary tract were the first chemicals utilized for this diagnostic procedure. The next shadow-casting substance, dry bismuth subcarbonate, was introduced by Chevalier Jackson to outline the bronchi and alveoli of the lung, following which Stewart and Lynah recommended the use of an emulsion of bismuth with olive oil for a similar purpose. The introduction of material opaque to the Rontgen-ray in the urinary tract (urography) is a diagnostic procedure of paramount importance. Up until the last decade its development has met with many difficulties and only by the perseverance of such pioneers as Tuffier, Klose, Voelcker and von Lichtenberg, and their successors, Cameron, Braasch, Kelly, Lowsley, Burns, Graves and Davidoff and others in recent years, has urography been brought to its present high efficiency. The first successful mapping of the urinary tract was accomplished by Voelcker and von Lichtenberg in 1906, using a colloidal silver compound, collargol, however, Tuffier in 1897, Schmidt and Kolischer in 1901, and Fenwick in 1905, had each independently used an opaque ureteral catheter for the outline of the ureters. This stimulated an intensive search for shadowgraphic materials suitable for use in the urinary tract. The method ran the gauntlet of various colloidal silver compounds, which, while satisfactory in shadow-casting, were damaging to the kidney (argyrol, nargol, electrargol, silver iodide, collargol etc.). Several instances of renal injury due to silver embolism and even some fatalities, due to the toxicity of these substances, were recorded during this period. In an effort to avoid the shortcomings of the various silver compounds, Burkhardt and Polano, in

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¹ Original research on campiodol carried out by Charles H Frazier, M D, and Mark A Glaser, M D, at the University of Pennsylvania. We are indebted to Dr George W Raiziss of the Dermatological Research Laboratories for the preparation of emulsified campiodol.

1907, and von Lichtenberg and Dietlen, in 1911, introduced oxygen which, however, proved unsuitable. In 1915 Burns announced the use of the first electrolyte for pyelography, thorium nitrate, claiming for it a relatively low toxicity. Due, however, to toxic effects and in some cases even death, this substance was discarded.

In 1918 the present era of pyelography began with the introduction of the utilization of the halogen salts, sodium iodide and sodium bromide (Cameron and Weld). In advocating the use of sodium iodide, Cameron stated that it was non-toxic, non-irritating to the mucous membranes, non-precipitating in the presence of urine, neutral, and of a viscosity slightly greater than distilled water.

The researches of Lowsley and later those of Graves and Davidoff demonstrated that 12.5 per cent sodium iodide was superior to all previous substances. This has been borne out by experiences even to the present time. Nevertheless, sodium iodide at times causes irritation of the renal and ureteral mucous membranes, bringing about pain and discomfort, the pain frequently colicky in character.

For some twenty-five years in France and Germany an iodized oil had been used for intramuscular and subcutaneous injection in patients who were in need of iodine therapy. Those administering this product accidentally discovered it cast shadows when exposed to the Röntgen-ray. In 1921 Sicard and Forestier began their experimental research upon this substance to determine its value as an opaque medium. Their researches were confined to iodized poppy-seed oil, lipiodol, which they found to be satisfactory in outlining the body cavities.

In recent years iodized oils (lipiodol and iodipin), as well as some of the newer colloidal silver preparations (neosilvol), have been used in pyelography.

In the central nervous system subarachnoid injections of lipiodol were used to determine the presence of spinal block and to outline the ventricles. Here again it had many disadvantages. For the purpose of obtaining a new substance in roentgenographic exploration of the subarachnoid space, Frazier and Glaser reviewed the subject of iodized oils, and with the aid of Dr. George Raiziss synthesized a new compound, iodized rape-seed oil (campiodol). It is an emulsion of this new compound that we wish to introduce as a new pyelographic medium.

EXPERIMENTAL STUDIES

Determination of the Most Suitable Shadow-casting Element—In the selection of elements for this problem, one must be governed by the ability of elements to cast X-ray shadows upon a photographic plate. In a general way this increases with the atomic weight and the specific gravity. The atomic weight is the more important factor and reaches its limit in shadow-producing power in the neighborhood of silver with an atomic weight of 107.7, decreasing slightly for elements of higher atomic weight. This is due to the form of the spectral absorption curve, which has a discontinuity

called, "the absorption limit" This limit varies from one element to the next The factors governing the quantity of the absorbing element in the path of the X-ray must also be considered, such as its proportion in the compound, its specific gravity and the concentration and total thickness of the solutions and suspensions

With these points in view, thirteen elements were studied, namely barium, bismuth, bromine, silicon, tungsten, strontium, lead, iron, copper, silver, gold, platinum and iodine In order to eliminate compounds of these elements low in shadow-casting power or low insolubility, the following technic was employed A saturated solution of compounds of the above-mentioned elements was made up in distilled water and its radiographic opacity compared with a 5 per cent solution of sodium iodide If the shadow-casting property were less than sodium iodide the solution was discarded, if equal, or greater, the solution was tested for toxicity by cisternal injection into the subarachnoid space of dogs It was found that iodine (atomic weight 126.9) was the element of choice, its compounds cast adequate shadows in low concentrations, and combined readily with many substances, the compounds so obtained were very soluble and of relatively low toxicity As contrasted with bromine, iodine belongs to that small group of elements possessing the property of selective absorption of the Röntgen-ray Iodine and its compounds present an opacity far greater than might be expected from its atomic weight The relative density of the X-ray shadow of an iodine solution increases with the penetration of the rays while that of bromine, for instance, decreases

Organic and Inorganic Compounds of Iodine—In an effort to determine the best iodine compound for roentgenographic visualization, the various iodides, iodates, periodates, iodophenolphthaleins, iodized fluoresceins and iodized oleic, benzoic, quinoline and thymol compounds were used Many of these products proved unsatisfactory because of their insolubility and others failed to cast sufficient shadows All of these, however, upon cisternal injection proved to be too toxic and for this reason attention was diverted to other substances

Iodized Oils—The ability of certain oils to bind iodine depends upon the presence in them of unsaturated fatty acids In such unsaturated oils iodine is held in firm union Deterioration of the final product depends upon the method of chemical preparation If there be an excess of free iodine in the final product, increased toxicity occurs Dark products resulting from the splitting off of iodine are considerably more toxic than the light transparent ones In this work oils of low specific gravity, high iodine value and low viscosity were selected First fish oils were chosen, and cod-liver oil, meeting the above prerequisites, was deemed particularly adaptable because of its rapid absorption by the human body This was converted into an iodo compound containing 55 per cent iodine which, however, gradually became dark, cloudy and ultimately turned black, menhaden oil acted similarly, sweet almond oil proved unstable These oils, however, upon sub-

arachnoid injection proved extremely irritating, but with rape-seed oil a product was finally obtained which proved well suited for all details

Iodized Rape-seed Oil, Campiodol—Rape-seed oil, also known as colza oil, is a vegetable oil of brownish-yellow color and is obtained from *Brassica napus*, *Brassica campestris* and *Brassica rapa*, which all belong to the family of Cruciferae. Rape-seed oil is composed of the glycerides of stearic, erucic and oleic acids. It is employed as an edible oil and for various industrial purposes. Its specific gravity is about 0.914. The saponification value ranges from 167 to 178, and the iodine value 93.5 to 105.6, its viscosity is 250 at 100° F. Upon iodization a light yellowish product (campiodol) is obtained with a specific gravity of 1.289. The elemental iodine content is approximately 43 per cent. This product deteriorates very slowly upon exposure to light or heat, and upon radiographic exposure an intense shadow is obtained, so much so that dilution products may readily be made without destroying its clinical value.

Toxicology—Campiodol has a very low toxicity. Dogs have withstood an oral dose of 6.75 cubic centimetres per kilogram of body weight. On injection of 1.5 cubic centimetres per kilogram of body weight into the internal carotid artery with the external carotid ligated no toxic effects were noted. In dogs weighing four to six kilograms four to six cubic centimetres have been injected by cisternal puncture into the subarachnoid space without toxic effects. Spinal fluid-cell counts on dogs in which two cubic centimetres of the iodized oil had been injected into the spinal subarachnoid space varied from 250 to 800 cells per cubic millimetre. At the end of five or six days the cell count ranged between five and fifteen cells per cubic millimetre. In clinical cases of hydrocephalus seven cubic centimetres of the oil were injected into the ventricles with a maximum count of 310 cells per cubic millimetre on the second day. In another clinical case 3.5 cubic centimetres were injected into the ventricles with a maximum count of nineteen cells per cubic millimetre three days after injection. In the spinal subarachnoid space of other clinical cases with an injection of 1 to 1.5 cubic centimetres the cell count varied from eleven to fourteen cells per cubic millimetre. From these figures we may conclude that campiodol has extremely slight irritating qualities, though it produced some cellular reaction, this was of a very low degree.

Emulsions—Utilization of a straight iodized oil for pyelography would be unsatisfactory for reasons already noted, namely, the high viscosity and non-miscibility. Emulsification reduces both of these undesirable properties. Emulsions may be prepared in various ways, using such emulsifying agents as egg albumin, gelatine, tragacanth and acacia. To reduce the shadow-casting property as little as possible and to make our final product of low viscosity, acacia proved to be the best emulsifying agent. In order to make a stable emulsion it was found that the final product would have to contain one-half of acacia solution and the other half iodized oil. This emulsion



FIG 1—Case No 43 020 Emulsified campidol, 25 per cent Normal kidney pelvis



FIG 2—Case No 10 291 Emulsified campidol, 25 per cent Right nephroptosis with two links in the upper ureter



FIG 3—Emulsified campidol, 19 per cent Early hydronephrosis Courtesy of Dr Robert V Day



FIG 4—Case No 31 079 Emulsified campidol 25 per cent Ureteropyelogram showing a hydronephrosis and hydro ureter

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FIG 5—Case No 41281 Emulsified campiodol, 21 per cent Tuberculous pyonephrosis



FIG 6—Case No 37831 Emulsified campiodol, 25 per cent Ureteropyelogram showing an atrophic hydronephrosis Note the clear definition of the multiple narrow ureteral strictures



FIG 7—Case No 27264 Emulsified campiodol 19 per cent Ureteropyelogram showing a reduplication of the kidney pelvis and an incomplete double ureter



FIG 8—Case No 30084 Emulsified campiodol 25 per cent Right nephroptosis Pyelogram is not well defined because patient moved during exposure

was prepared in sterile ampules and sealed, and the product further sterilized by exposure to pressure at a temperature of 100° C. Upon bacteriological examination this product proved sterile.

CLINICAL STUDIES

Iodized oils, though casting adequate shadows, gained little favor in urography because of their inability to meet all the prerequisites of good pyelography. These oils were too viscous to readily flow into the renal pelvis unless great pressure could be exerted, the use of special syringes being recommended. Ready drainage would not occur from the kidney pelvis and would occasionally result in obstruction. Air accidentally introduced might produce a trap with subsequent obstruction. Furthermore, these substances being oils were not miscible with the urine in the kidney pelvis and often gave distorted pyelograms. In addition pain was a frequent occurrence due to the resulting obstructions.

Iodized oils have, however, properties desirable for a good pyelographic media. Non-irritation, or lessened irritation, and very low toxicity, due to their inertness as chemical compounds, are of value. The more widely used 12.5 per cent sodium iodide, while having many advantages as a pyelographic medium, is an electrolyte and therefore in numerous instances irritating to the mucous membranes of the urinary tract. Pyelography has, therefore, become a distressing procedure in some cases due to the irritation of such a pyelographic medium as 12.5 per cent sodium iodide.

While the primary object of urography is to visualize the urinary tract so as to demonstrate the normal or abnormal conditions, the comfort of the patient during a cystoscopic study should be considered. Wishing to utilize the iodized oils because of their desirable properties, consideration was given to the solving of their shortcomings, namely, non-miscibility and great viscosity. It was found that by emulsifying campidol with an acacia solution a stable compound was obtained which was miscible with water and of low viscosity. These properties, in addition to such advantages of iodized oils as non-irritability, low toxicity and excellent shadowgraphing, would make an excellent pyelographic medium. We feel that emulsified campidol is such a medium.

Emulsified campidol is a stable, grayish-white, oily emulsion, having a specific gravity of 1.097, a viscosity of slightly more than twice that of water, non-irritating, very low toxicity and casting excellent roentgenographic shadows in solutions varying from 7 per cent to 10 per cent iodine content. By its use we have eliminated pain, burning, and other signs of discomfort, such as are present in many cases in which 12.5 per cent sodium iodide has been used. Nevertheless, over-distention of the renal pelvis during injection will produce pain. The non-irritability of emulsified campidol was especially demonstrated in one case. A pyelogram was made with the emulsified campidol and the patient did not complain of any discomfort nor irritation. The emulsion was permitted to drain out and a second pyelogram made.

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with 12.5 per cent sodium iodide. The patient immediately complained of a burning in the lumbar and bladder regions which continued for several hours.

The emulsion is miscible with water in all dilutions and therefore mixes readily with the urine, permitting good drainage from the pelvis and ureter (Fig 8b). This eliminates the possibility of obstruction and renal pelvic retention as well as distorted pyelograms caused by other viscous iodized oils. There is no precipitation with the urinary salts.

Clinical experience to date has shown that emulsified campiodol gives pyelograms equal to 12.5 per cent sodium iodide and superior to the other iodized oils. Its shadow-casting properties are excellent in people of all weights. The exact definition of the calices, pelvis, ureter and even to the papillae in the minor calices is clear cut. The withdrawal of the ureteral catheter into the lower ureter for the injection of ureterograms is rarely accompanied by the usual reflux into the bladder as with sodium iodide, thereby producing a good ureteral outline and eliminating irritating bladder symptoms (Figs 4 and 6). This advantage may be explained by the fact that the emulsified campiodol has sufficient viscousness to prevent reflux, not possessed by 12.5 per cent sodium iodide.

The syringe method was used because the emulsion is, as yet, too viscous for the gravity method. The complaint of any pain or discomfort by the patient in the kidney or ureteral region was the signal for the cessation of injection. In carrying out dilutions of the emulsified campiodol solution, a reduction from 10 per cent to 7 per cent elemental iodine content has been made and favorable pyelograms obtained (Fig 5). In this manner the viscousness of the emulsified campiodol was reduced still further. We hope later to adapt this emulsion to the gravity method by making the proper dilutions.

Emulsified campiodol has been successfully used as a pyelographic medium in twenty-five cases, of which six pathological ones are appended. We believe from our clinical experience that it possesses such advantages as good shadow-casting, low toxicity, good miscibility, low viscosity and especially, non-irritability which justifies its further use, and we hope to report additional experiences.

SUMMARY

1. Emulsified campiodol, used as a pyelographic media, is inert, non-irritating and non-toxic, it is miscible with water and does not precipitate with the salts of the urine and possesses excellent shadowgraphic properties, both as to intensity and to detail.

2. Emulsified campiodol has been used in twenty-five cases with a minimum of irritative symptoms and therefore possesses a distinct advantage over 12.5 per cent sodium iodide.

3. Emulsified campiodol gives excellent ureterograms.

4 Emulsified campidol mixes with the urine in the kidney pelvis, its viscosity is much less than that of other iodized oils and hence is superior to them

5 Emulsified campidol is a stable emulsion of iodized rape-seed oil, composed of iodized rape-seed oil, acacia solution and distilled water

6 Campidol is an iodized rape-seed oil containing approximately 43 per cent elemental iodine

ILLUSTRATIVE CASE HISTORIES

CASE I—No 10-291, female, forty-two years of age, housewife, entered the Los Angeles General Hospital, October 17, 1928, with complaint of pain in the back, pain

in the bladder, frequency and burning, nocturia three to four times, and weakness. Bladder symptoms for the last ten days. Pain in the back for the last six days. Physical examination revealed some tenderness in the right kidney region and sacroiliac joint. Cystoscopic examination bladder normal, kidney study showed small amount of pus and occasional Gram-negative bacilli in the right kidney urine, intravenous phthalein appeared from the right kidney in six minutes and left kidney in four minutes, the right kidney returned 15 per cent of the dye and the left kidney 27.5 per cent in twenty minutes, no bladder leakage. Right pyelogram (Fig 2) performed with campidol emulsion, in the prone and vertical positions, showed the right kidney to be somewhat low and the ureter to have a kink near the pelvis, the pelvis was enlarged, the calices appeared normal. *Diagnosis*—Right nephroptosis with ureteral kink.

CASE II—No 30-084 female, sixty years of age, entered the Los Angeles General Hospital, October 26, 1928, with the complaint of sugar in the urine, severe pain in legs and left shoulder, difficulty in urination

FIG 8b—Case No 30-084. Ten minutes later showing a nearly complete drainage of the kidney pelvis

The past history showed patient to have been in hospital six months previously with the diagnosis of diabetes mellitus. The average blood sugar was 368 milligrams sugar per 100 cubic centimetres of blood, and patient had sugar in the urine, and a marked pyuria. Cystoscopic examination and kidney study revealed a marked cystitis, with pus in the right kidney urine and none in the left, intravenous phthalein appeared in three minutes from both sides and 10 per cent of the dye was returned in eighteen minutes from the right side and 9 per cent from the left side, bladder leakage 15 per cent. Right pyelogram (Fig 8a) with campidol emulsion showed the kidney pelvis to be somewhat large, with the kidney dropping about two inches in the vertical position, resulting in a ureteral kink. *Diagnosis*—Right nephroptosis with early hydronephrosis, and ureteral kink.

CASE III—No 31-079, female, fourteen years of age, entered the Los Angeles General Hospital, September 12, 1928, with complaint of pain in both lumbar regions, fever, frequency of urination and headache. The past history is irrelevant, except that patient has had headaches for years, presumably referable to her eyes. The present

illness began three weeks ago. The patient's symptoms becoming progressively worse, has lost some weight, but does not know how much. There are no particularly abnormal physical findings. Repeated urine analyses showed much pus. While in the hospital patient suffered a recurrence of acute symptoms with a temperature of 104° F, and marked pain in the left renal region. Cystoscopic examination revealed a marked cystitis. The left kidney contained much pus and streptococci in short chains, the right kidney was uninfected. Intravenous phthalein appeared in five minutes from the right kidney with an output of 25 per cent in twenty minutes, while only a trace of the dye appeared on the left side. Left pyelogram (Fig 4) made with emulsified campiodol showed an hydronephrosis and hydro-ureter. Diagnosis confirmed by operation.

CASE IV—No 41-281, female, nineteen years of age, entered the Los Angeles General Hospital, December 5, 1928, with complaint of frequency and burning on urination, pain in lower abdomen and leucorrhœa. Past history irrelevant. Present illness began about three months ago, since which time patient has become progressively worse until at present there is a diuria of twelve to fifteen times, and a nocturia of every half hour. Physical examination showed a poorly-nourished Mexican woman. Temperature and pulse slightly elevated. Tenderness in both lower abdominal quadrants. Vaginally a lacerated cervix with marked endocervicitis and tenderness in both fornices. Urine contained much blood and pus, but no organisms. Cystoscopic examination revealed an ulcerative cystitis, most marked about the trigone. Ulcerations suspicious of tuberculosis. Left ureter obstructed at ten centimetres, but passed by means of stylet. Right kidney uninfected, left kidney contained a great number of pus cells, but no organisms found in the Gram and acid fast stains. Intravenous phthalein appeared on the right side in five minutes with a 25 per cent output in twenty minutes, appearance time on left side fifteen minutes with a 3 per cent output. Left pyelogram (Fig 5) with emulsified campiodol showed a marked destruction of the kidney pelvis suggestive of a pyonephrosis. *Diagnosis*—Tuberculous pyonephrosis of left kidney. Operation confirmed diagnosis.

CASE V—No 37-831, female, fifty-three years of age, entered Los Angeles General Hospital, November 14, 1928, with the complaint of frequency and urgency of urination, burning, nocturia five to six times, and pain in the right kidney region. Past history showed patient had an uterine operation seven years ago. Present history began about four weeks ago when patient had a severe attack of pain on right side lasting four days. Had a similar attack four months ago on the left side. Physical examination revealed some tenderness in the right lower quadrant and along the ascending colon. Cystoscopic examination showed a bladder mucosa normal, bladder neck smooth, right ureteral orifice normal in appearance and function, left ureteral orifice functionless, right ureter catheterized to kidney, but left ureter catheterized for fourteen centimetres, kidney study showed right kidney to be uninfected and left kidney to be functionless, intravenous phthalein appeared in five minutes on the right side and returned 50 per cent in twenty minutes, no dye was obtained from the left kidney, bladder leakage showed a trace of the dye. Left ureteropyelogram (Fig 6) made with campiodol emulsion. *Diagnosis*—Atrophic hydronephrosis.

CASE VI—No 27-264, female, fifty-one years of age, entered the Los Angeles General Hospital with frequency of urination, dysuria, backache, chills and fever. Former entry with same complaints seventeen months ago, at which time patient was found to have a left incomplete double kidney and hydro-ureter. With exacerbation of symptoms patient was advised to reenter hospital. Physical examination essentially negative. Cystoscopic examination under spinal anæsthesia revealed a marked cystitis and a small grayish ulcer behind the interureteric ridge on the right side. The left ureteral orifice is gaping and the right is normal in appearance. Both ureters catheterized. Kidney study showed the left kidney to be infected (*B coli*) and the right kidney negative. Intravenous phthalein showed an appearance time of three and one-half

minutes on the right side and six minutes on the left side. The right side returned 6 per cent of the dye and the left side 1 per cent in twenty minutes, bladder leakage 12.5 per cent. Left ureteropyelogram with campiodol emulsion showed a duplication of the kidney pelvis (Fig 7). Diagnosis confirmed at operation.

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TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

STATED MEETING HELD MARCH 13, 1929

The President, DR FRANK S MATHEWS, in the Chair

GOITRE PROBLEMS

DR MORRIS K SMITH presented patients from the Thyroid Clinic of St Luke's Hospital to illustrate certain problems in the treatment of goitre

CASE I—A man of about thirty-five years, came to the clinic in October, 1927. He presented a moderately severe case of Graves's disease with well-marked exophthalmos, tachycardia and tremor. His weight was 112 pounds, basal metabolism +40. Treatment consisted of hospitalization for six weeks and X-ray continued over a period of fourteen months. He began to improve at once. At present, one and one-half years after beginning treatment, he seems pretty well, weight is 130, a gain of eighteen pounds, and basal metabolism is +24. He is working. He is shown to demonstrate therapy by X-ray, of which little is said at present. It is a method which has given some excellent results in the clinic although requiring a long period of treatment.

CASE II—An unmarried woman entered the hospital eight months ago complaining principally of rapid heart action. Her history extended back three years, although exophthalmos had been present only in the previous two months. Her weight was 145 pounds, basal metabolism +40. Subtotal thyroidectomy was done by the speaker. Four weeks after operation basal metabolism was +7.

Two and one-half months after operation she attempted to resume part time work, but soon noticed palpitation. Basal metabolism was found to be +34. She received six X-ray treatments. At present, six months after operation, she has gained fourteen pounds and her basal metabolism is +9. She is not working and feels pretty well on a regimen of rest.

This patient is shown to demonstrate disappointment as to promptness of recovery, as well as to emphasize the necessity for careful follow-up supervision of these patients. It seems probable that a sufficiently radical operation was not done in the first instance.

CASE III—A woman who was operated on by the speaker ten months ago. She had been sick for two months with moderate exophthalmos and weight loss of eighteen pounds. Basal metabolism was +46. Following operation she was very hoarse and laryngoscopic examination revealed partial paralysis of the left recurrent laryngeal nerve. Two months later her voice seemed to be normal although there has not been an opportunity for another laryngeal examination. Three months after operation she had gained twelve pounds and basal metabolism was zero.

This patient is presented as an apparent recovery after partial nerve

injury and as a satisfactory result thus far as to general condition, in an early case of Graves's disease

CASE IV—A colored woman who was first seen two years ago. There was a slight exophthalmos and tremor, well-marked goitre. Weight was 135 pounds, basal metabolism $+43$. She has had X-ray therapy. During a period of sixteen months nine basal metabolism tests were made, the lowest $+25$, the highest $+54$ and the last, six months ago, $+49$. Gain in weight has been slight. She has seldom admitted nervousness. She has refused operation. She is presented as a case in which metabolic changes are well marked while nervous manifestations are slight.

CASE V—A young woman who came to the clinic a year and a half ago. Nervousness was the chief symptom. She had lost sixteen pounds in eight months. There was no visible goitre, tremor very marked, pulse rapid, basal metabolism $+22$. She has been followed in the thyroid and neurological clinics, including a period of hospitalization. She received X-ray over a period of three months. The highest basal metabolism was $+38$, lowest and most recent $+5$. Her general condition remains much the same. She is able to work.

There has been much discussion as to whether this patient had Graves's disease. She is presented as an individual with marked nervous and borderline metabolic manifestations.

CASE VI—A man of thirty-two years has been followed fifteen months. His chief symptoms were weakness, loss of weight, palpitation and nervousness. He had slight exophthalmos, evident thyroid enlargement, marked tremor and tachycardia. He weighed 94 pounds. Basal metabolism was $+18$. He was hospitalized for six weeks. The outstanding features in this case are prompt gain in weight from 94 to 120 pounds and persistent low basal metabolism, never over $+18$, and down to $+7$ at last report six months ago. He has had no X-ray. Advisability of operative therapy has been often discussed.

This patient is also presented as a case in which nervous manifestations predominate. The only feature lacking to substantiate a diagnosis of Graves's disease in him was a more definite elevation in metabolism.

DR GEORGE M. GOODWIN (by invitation) said that the last two cases belonged in that group in which the question as to the advisability of surgical therapy was a difficult one. Both cases showed the nervous factors much more than the metabolic. In the nervous symptoms they resembled closely cases of thyroid toxæmia, yet their basal metabolic rate had been normal, or almost normal, throughout. These did not seem to him to be true thyroid cases.

DR ALEXIS V. MOSCHCOWITZ felt from a very casual examination of Doctor Smith's cases of Graves's disease, that with the exception of Case III, all are still rather well-marked cases of Graves's disease, and he is also under the impression that all of them would be benefited by a subtotal thyroidectomy.

Doctor Smith has laid a great deal of stress upon the lowering of the basal metabolism. While this is a very important item, a lowered basal metabolism does not denote a cure of a patient suffering from Graves's disease. As a matter of fact, it has been Doctor Moschcowitz's experience

OSTEOSARCOMA

that patients who had been operated upon for Graves's disease, even if they had a normal or subnormal basal metabolic rate, may still have very distressing residual symptoms

Doctor Moschcowitz also wished to again emphasize how much harm the indiscriminate use of iodine may do. He has, within the past few years, seen all sorts of diseases of the neck accompanied by swelling, treated by iodine, even if not connected with the thyroid gland. It should be reiterated again and again that the use of Lugol's solution is indicated only as a pre-operative measure in cases of Graves's disease.

DR RICHARD LEWISOHN said that over twenty years ago he had treated a number of cases of exophthalmic goitre with X-ray therapy at Czerny's clinic in Heidelberg. Some of these cases showed improvement when reexamined six months to a year afterward. His objection to X-ray and radium therapy for exophthalmic goitre is that it makes subsequent operation very much more difficult on account of extensive lesions due to the radiation.

DR SMITH, in closing, said that when a patient with Graves's disease has had the basal metabolism brought back to normal and gains weight she is not necessarily free of the symptoms of the disease. He thinks it is the exceptional case who is well in every respect.

He does not feel that Case I can be considered wholly cured of Graves's disease, but presented him as a man, originally quite ill, treated by rest and X-ray, who is now pretty well and able to work. It is well to remember that radiotherapy is a method of treatment which can be used when operation is refused or contraindicated.

OSTEOSARCOMA

DR WILLIAM B. COLEY presented the following patients:

CASE I—*Sarcoma (endothelioma type) of tibia. Extensive multiple metastases to bone and soft parts following amputation. Complete disappearance under systemic injections of the mixed toxins of erysipelas and bacillus prodigiosus, alone. Patient well three years later.* (This case was reported by Doctors Christian and Palmer in the *Military Surgeon*, July, 1927, and in more detail and with full illustrations in the *American Journal of Surgery*, February, 1928.)

Captain G. B., male, thirty-one years of age, had his left leg amputated at the middle third of the thigh on September 21, 1925, for a tumor of the shaft of the tibia, which, on microscopical examination by Dr. Ewing Taylor, was pronounced a very cellular myeloid sarcoma, small polyhedral cells. With this diagnosis, Dr. James Ewing and Dr. E. A. Codman concurred. While the patient complained of pain in the stump, a roentgenogram taken November 24 failed to reveal any evidence of a recurrence. On February 23, 1926, four months after the amputation, roentgen-ray examination showed very extensive recurrence in the stump with marked destruction of bone. January 25, or one month before the recurrence in the stump was noted, a tumor mass the size of a man's fist appeared over one aspect of this stump, and

one the size of a lemon over another aspect. There were metastatic tumors (two inches in size) in the inguinal region, and another one above the umbilicus.

Treatment with the mixed toxins was begun at once, in early January, 1926, the initial dose of 25 minims was gradually increased to 65 minims.

The dosage in this case is of extreme importance. Up to January 25, the highest dose 65 minims, was followed by little reaction, except after the first few doses. Yet the mass in the groin had disappeared and the mass in the umbilicus was much smaller. The dose was increased by one minim a day from February 2 to February 20, when it had reached 18 minims. The treatment was then discontinued on account of the weakness of the patient. A new and extensive growth had appeared in the femur-stump and there was much œdema of the good leg. May 5, several small metastatic nodules appeared under the skin of the abdomen. During May and June the patient grew worse steadily, with metastatic growths appearing in many parts of the body, among which were a considerable involvement of the right clavicle and multiple tumors of the scalp, cranial bones and cervical vertebræ. The maximum growth that the tumor of the stump had attained was thirty-one inches. The end of the tumor of the stump had broken down with foul discharge.

The toxins were resumed on August 2, 1926, the initial dose of 2 minims being increased daily by 1 minim up to 17 minims. By this time marked improvement was evident, as shown by a marked decrease in the size of all the tumors, the stump had nearly healed.

An interval of rest from September 4 to September 19 was followed by a third series of injections, which were given daily for three weeks. On November 22 the patient's general condition was excellent, he had gained thirty pounds in weight. The stump-circumference was seventeen inches (formerly thirty-one inches), the discharging wound had healed, the multiple tumors of the abdomen, groin, scalp, clavicle and skin had all disappeared. The patient was discharged from the hospital with no evidence of disease on December 5, 1926. As a precaution, a fourth series of treatment was given from February 13 to March 17, 1927, every third day, the initial dose of 3 minims being carried up to 30 minims.

The case was republished in the February, 1928, issue of the *American Journal of Surgery*. In January, 1929, he was in the best of health with no evidence of a recurrence. He is still well at the present time, March 1929, two years after cessation of the treatment.

Doctor Coley remarked as to end results in general that up to the present time there had been observed at the Memorial Hospital and the Hospital for Ruptured and Crippled, forty-six cases of endothelioma or endothelial myeloma. Of this group, eighteen are alive and well from three to twenty years. The treatment employed in these eighteen cases was as follows: Toxins alone in five cases, toxins and amputation in seven cases, and toxins and radiation in six cases. There were no apparent recoveries in the group of eleven cases treated by radiation alone. Excluding the eleven cases treated by radiation alone, there remain thirty-five cases treated by toxins alone or toxins and radium, with eighteen well from three to twenty years, or 50 per cent.

The endothelioma or Ewing type of sarcoma was described by Howard and Crile in a paper which was published in the *ANNALS OF SURGERY*, September, 1905. This contained a report of nineteen cases that had been found in the literature in addition to four cases that had come under their personal observation. One of these cases was cured by surgery. Little was known or written about this type of tumor until 1921 when Ewing reported a case with a detailed clinical and microscopic description of the condition.

While there is still doubt as to the exact origin of this tumor, whether it arises from the perivascular endothelium or from endothelial cells of bone-marrow, as Ewing believes, or from the reticulo-endothelial system, it is universally admitted that it forms a separate class by itself. Furthermore, unlike the ordinary osteogenic sarcoma, it is exceedingly sensitive to both radiation and toxins.

In regard to the frequency, the endothelioma type was found to comprise about 20 per cent of the entire group of malignant bone sarcoma (exclusive of giant-cell sarcoma) personally observed, that is, forty-six cases of endothelioma were found in the entire group of two hundred cases of sarcoma of the long bones.

If anything, this type is more malignant than the ordinary osteogenic sarcoma, and is exceedingly prone to early metastases. Few cases are saved by amputation alone. From the result obtained in the case just presented, he thought that there is little reason to doubt that the limb could have been saved had prompt conservative treatment been instituted. In November, 1928, he showed before the New York Physicians' Association another case of endothelioma of the tibia with extensive metastases to the glands of the groin at the time of amputation and further metastases to the iliac fossa and lungs after amputation. In May, 1920, the patient was put upon the mixed toxins, which were kept up for four months, and in addition he received one application of the radium pack to the iliac fossa. He made a complete recovery and was in excellent health at the time of presentation.

It is evident that a disease so prone to early generalization requires some systemic method of treatment. As far as he knew, the toxins of erysipelas and bacillus prodigiosus is the only systemic method that has met with any success in the treatment of these tumors. With radiation alone it is often possible to cause prompt and apparently complete disappearance of the primary tumor, but almost invariably, after a longer or shorter period of time, metastases or multiple tumors appear elsewhere and the disease proves fatal in the end. Putti, in his recent John B. Murphy Oration in *Surgery (Surgery, Gynecology and Obstetrics)*, March 1929, on "Malignant Bone Tumors," states: "I have noted the extreme sensitiveness of soft sarcomata, more especially the endotheliomata, for which a few doses suffice to clear away all external evidence of the tumor. But this disappearance is only temporary. Indeed, I have gained the impression that, in some cases, radiation hastened the formation of metastases."

Personally the speaker believes that the ideal treatment of these tumors is a combination of the local effect of radiation with the systemic effect of the mixed toxins, being careful to avoid giving too heavy doses of radium, which, in his experience, which coincides with Putti's, sometimes hastens the development of metastases

CASE II—Inoperable sarcoma (endothelioma type) of humerus Complete disappearance under toxins and radium Patient well four and one-half years later

E M, male, forty-seven years of age, was referred to Doctor Coley by Dr William C Sheehan and Dr John B Deaver, of Philadelphia, July 24, 1924, with a history of having tripped over a low fence, about a year and a half previously, and fractured the left humerus at the upper third One year later a tumor developed at the site of the injury Physical examination showed the left shoulder markedly swollen on the outer and anterior aspect, the swelling occupying the whole region of the deltoid, and extending up to the tip of the clavicle and involving the upper third of humerus, it was soft in consistence, semifluctuating, and extended out to the pectoral muscle The measurement over the axilla and tip of the clavicle was twenty-one inches, five inches higher than the other arch, while the circumference at the highest point of the axilla was fifteen inches Motion at the shoulder was considerably limited, the left hand could be raised as high as the patient's chin but not to the top of his head, abduction was about forty-five degrees The skin was normal in appearance and the veins were not dilated

The roentgenologic and clinical evidence was so clear that it was possible to make a definite diagnosis without a biopsy Most of the surgeons who saw the patient believed his condition to be inoperable, therefore it was decided wise to try conservative treatment Injections of the mixed toxins of erysipelas and bacillus prodigiosus were started at once supplemented by a massive dose of radium (10,000 mc hours) at seven centimetres distance over three different areas In four weeks the tumor had diminished five inches in circumference and the patient had regained his lost weight He proved extremely susceptible to the toxins, a very small dose producing a rise of temperature to 104.5° In December, 1924, there was evidence of some slight increase in the swelling of the arm, and another radium pack was applied, the toxins being continued once a week until April, 1926

Physical examination in April, 1926, failed to show any evidence of enlargement of the arm, the patient's general condition was entirely normal, and he was performing his regular work He had been able to resume work within two months of the beginning of treatment A roentgenogram taken on November 23, 1926, showed no evidence of disease, function normal Another roentgenogram taken today also fails to show any evidence of disease The patient is in excellent health, four and one-half years after the beginning of treatment

This case has been reviewed by the Bone Sarcoma Registry committee (see Case No 596) and diagnosed as an endothelioma or Ewing's sarcoma

It is interesting to note the method of administering the toxin treatment in this case While for many years Doctor Coley had relied almost exclusively on intramuscular injections, in the present case, by accident his house sur-

geon gave the second or third dose (25 minim) directly into the tumor; this was followed by a very severe reaction, temperature of 105° . The effect on the tumor during the next two or three days was quite noticeable so that he continued to give local injections almost exclusively during the next month or so. This is the method which he employed in his earlier cases.

During the last two years he had used intravenous injections in a considerable number of cases, getting severe reactions from initial dose as small as $1/48$ minim. The great advantage of this method is the certainty of producing the desired reaction without the local reactions which in some cases are rather disagreeable. As far as can be ascertained the results following the intravenous injections are a little better than those following systemic injections, and as yet no fatalities have occurred. The dose is gradually increased as the susceptibility is diminished, $1/48$, $1/40$, $1/36$, $1/30$, etc., of a minim. In one patient the dose was gradually increased so that at the end of eight months the patient was getting thirty minims. This patient was not at all sensitive to the toxins and required a dose of twelve minims intramuscularly before any reaction was obtained. The toxins should never be given intravenously until the susceptibility has been tried out by intramuscular injections.

DR HOWARD LILIENTHAL believed Coley's fluid ought to be used a great deal oftener than it has been, and is being, used. He has had a number of patients, at least twelve, some of whom have been absolutely hopeless and inoperable sarcoma of various types, who have entirely recovered and have remained well after treatment by Coley's method only. He regretted that Doctor Coley is using radiation with his fluid as he feels there is no advantage in it. Massive X-ray radiation is apt to produce blood changes and make it difficult for the patient to resist the reactions which follow the administration of Coley's fluid.

DOCTOR COLEY reported that he agreed with the opinion expressed by Doctor Lilienthal, that the toxins alone without radiation were able to effect a cure in this endothelioma group. He believed that the first case presented this evening, in which very extensive multiple metastases to the bone and soft parts had disappeared under toxins alone and the patient had remained well for three years, would seem to furnish satisfactory evidence to this effect. Furthermore, he agreed with Putti that there was danger of very heavy radiation of a highly vascular endothelial tumor resulting in early generalization of the disease by a too rapid breaking-down of the tumor permitting some of the living cells to escape into the circulation. Doctor Coley had observed several cases in which it seemed difficult to explain in any other way the rapid generalization that had occurred. If a combination of toxins and radiation were to be employed, he advised administering the toxins first, for a week or more, and getting the patient somewhat under their influence, thus lessening the chances of metastases developing. Doctor Coley said it was interest-

ing to note that in the series of fifty-four cases of endothelioma collected by Connor (fifty-two from the Bone Sarcoma Registry) four of the nine five-year recoveries were his (Doctor Coley's) cases, and in all of the four cases the toxins had been used. He stated that there was one case of endothelioma at the Memorial Hospital that had recovered under radiation alone but in this case no microscopic examination had been made and there had always been some doubt of the correctness of the diagnosis of endothelioma. In the series treated by Doctor Coley, the limb had been saved in seven cases. He called attention to the fact that certain bones had a predilection for this disease. In his series the femur was involved in twenty cases, the tibia in seven, and the humerus in five cases.

GAUCHER'S DISEASE

DR HAROLD E. SANTEE presented two cases of Gaucher's disease's who were presented before this Society May 11, 1927 (See ANNALS OF SURGERY, November, 1927). To briefly resume the cases, it may be stated that C. S., now thirty-one years of age, suffered a "sprain in the left hip" in March, 1925. He came under observation in October, 1926, at which time the important findings were anæmia, an enlarged liver and spleen and a painful left hip of which an X-ray showed slight irregularity and loss of detail in the lower half of the margin of the head of the left femur. In March, 1927, these changes had progressed to distinct rarefaction about the head of the left femur and about the pubic and ischial ramæ. The patient was admitted to Bellevue where a diagnosis of Gaucher's disease was made on the evidence of pingueculæ in the eyes, large spleen, large liver and bone changes. The spleen was extremely large, reaching into the pelvis. After preliminary transfusion splenectomy was done on April 5, 1927. A small section of liver and a lymph node at the hilus of the spleen were also removed. They showed changes characteristic of Gaucher's disease. The convalescence was stormy. Directly following operation a transfusion was given. A post-operative pneumonia developed and it is interesting to note that at the height of his pneumonic infection his white blood cells were only 4800, polymorphonuclears 58 per cent, hæmoglobin 55 per cent. Definite jaundice appeared, with high icteric index (72). Infection occurred in the wound. Altogether convalescence was very slow. The spleen was a nodular type of spleen, more nodular than the only other one reported in Gaucher's disease, which was examined by Ludwig Pick in 1926. He received three more transfusions while in the hospital. He left the hospital in May. In September he had gained twenty pounds and looked remarkably well. He was maintaining his hæmoglobin at 70 per cent, red blood cells were 3,500,000, white blood cells, 8400, polymorphonuclears 36 per cent, transitionals 7 per cent, lymphocytes 47 per cent, large mononuclears 7 per cent. He was relieved of indigestion and sense of weight in the abdomen, of which he had complained in the spring. His liver remained the same size. His hip showed no improvement.

At present, approximately two years after the splenectomy his hæmoglobin is 75 per cent, red blood cells 3,800,000, white blood cells 12,000, polymorphonuclears 33 per cent, lymphocytes 32.5 per cent, large mononuclears 30 per cent. He is maintaining his general health, apparently, in an excellent manner. He feels well and suffers practically no indigestion. Recent

skiagraphs of the hip show marked rarefaction or absorption throughout the head and neck of the left femur from acetabulum to intertrochanteric line. There is a faint line suspicious of pathological fracture at junction of head with neck. Areas of bone rarefaction are present in the pubic ramus and in the left ischium. Resection and fusion of this hip were advised for this patient long since but have not been accepted by him.

The brother of this patient is the second case presented. He was also shown before this Society two years ago. His history apparently dates back to 1917, when a diagnosis of malaria (spleen?) was made. Epistaxis and bleeding from the mouth brought him under observation at that time. In the hospital, later, an enlarged liver was found and periodically since that time he has been under observation for this enlarged liver. During the past five years this patient has noticed anæmia, with shortness of breath and asthenia, some indigestion and a constant feeling of discomfort in the right upper abdomen and across the abdomen, particularly on leaning over. He, too, shows the pingueculæ described by Brill, a liver enlarged to the level of the umbilicus, and a spleen which is enlarged to a similar level. In the past two years he has changed his job because of the symptoms associated with his anæmia, which were dyspnoea on exertion, asthenia and also the weight and discomfort in the abdomen. Clinically, in comparison with his brother, he shows greater anæmia and greater asthenia. The spleen is apparently about two fingers' breadth larger than two years ago. The liver is apparently the same size.

In commenting on these two cases two years ago it was stated that in this disease of the reticulo-endothelial system the manifestations vary quite markedly, as illustrated in these two cases, one marked by chronicity (twelve years), anæmia and symptoms referable mostly to the liver, the other marked by less chronicity (now five and a half years), obvious bone changes and pain and discomfort referable mainly to the spleen. The statement was made at that time that reasoning by analogy, can splenectomy be justified in the second case on the grounds of relief to the damaged liver, as in splenectomy in cirrhosis, as possible relief in a marked secondary anæmia, or as a mechanical removal of a heavy, painful, pressure-producing organ? Certainly no one expects to cure a diffuse disease of the character of Gaucher's by the removal of a single involved element. Relief of major symptoms, however, seems indicated even if it involves a major operation. With the possibility of indirect beneficial results, such as relief to a damaged liver and some benefit to the anæmia, splenectomy seems to be justified. The course of the second case seems to have justified the procedure. A burdensome, pressure-producing organ has been removed. The patient maintains his hæmoglobin at about 75 per cent, or 20 per cent more than he showed at the time of operation, his red blood cells are increased in number, his pigmentation has apparently diminished and he eats and lives with much less indigestion and abdominal discomfort. No splenectomy was performed on the other brother. His symptoms after two years seem to maintain themselves as largely related to the enlargement of the liver.

DR ALLEN O WHIPPLE said that these cases closely resemble two of his own cases of Gaucher's disease reported by Stout and Cushing. They were brother and sister and the sister had almost identically the same bone changes as those shown in the roentgenograms of Doctor Santee's cases. Following splenectomy, she was operated upon by Doctor Farley at the New York Orthopedic Hospital and the head, and a portion of the neck of the femur were resected. Sections from this tissue showed perfectly characteristic Gaucher cells. This patient has been followed now for four years and the restoration of function and apparent arrest in disease of the femur are remarkable. This girl is very active, she dances, she swims, she works. Of course, there is still shortening, but it shows very little. Following the splenectomy she has maintained her hæmoglobin and red cell count, she has lost pigmentation, and has maintained her weight. The arrest of the process in the femur cannot be explained, yet the patient is certainly a great deal better and healthier than she was four years ago.

DOCTOR SANTEE, in closing, remarked that one could look at Gaucher's disease as a disturbance in lipid metabolism and that the condition should be viewed as such a disturbance rather than as a disease *per se*. The changes present are replacement changes in every way and if one could control lipid metabolism in anyway, probably these changes could be controlled. It is difficult to see, however, how this end can be accomplished. It is remarkable how specifically the bone changes in the condition seem to pick out the head and neck of the femur for involvement, at least in the cases published. The condition is not incompatible with fairly long life, as is shown by the fact that some of these cases have gone well into fifty years before dying.

BRONCHOSTOMY COMPLICATED BY SEVERE HEMOPTYSIS

DR HOWARD LILIENTHAL presented a boy, thirteen years of age. His tonsils had been removed five years before under ether anaesthesia and six weeks later cough began with fever running to 103°, in December, 1923. Soon after he was operated upon by another surgeon for what appeared to be an empyema of the left chest, a rib resection being made high in the axilla. Much foul pus escaped. An intercostal counter incision was made low down in the back. A bronchial fistula developed at the upper wound, and gradually the discharge diminished and finally ceased, the fistula becoming skin lined and perfectly dry. Not until nearly five years after his operation were there any alarming symptoms but then there was sudden severe hæmorrhage both at the wound and by hemoptysis. Slight cough with repeated hemoptyses persisted. Doctor Lilienthal saw him September 29, 1928. He was well nourished but there were clubbed-fingers and there was a broncho-cutaneous, left axillary, fistula of large size. This fistula ran through the left fourth rib. There were no fluid levels and nothing suggestive of abscess, but neither was there any discharge from the bronchial stoma.

September 28, Doctor Lilienthal excised the skin about the fistula following it down to the hole in the rib. Then he resected this rib removing it from the chest wall and permitting the entire sinus with the skin about the fistula to slip through the opening in the bone. Dissection was made down to the lung and

then using the sinus as a handle he split the entire tract open down into the cavity within the lung. The walls were somewhat trabeculated and lined with mucous membrane. He then cut away about two-thirds of the wall of the abscess and burned the remainder with the actual cautery so as to destroy the epithelium. The wound was now packed with rubber dam, but the packing was placed not within the cavity but toward the mesial side of the abscess so as to compress its walls. A few days later the rubber dam was replaced by gauze and the dressings were changed daily. In a few weeks the wound was completely healed and the fistula closed. The patient remained well.

This case demonstrates the uncertainty of life with a broncho-cutaneous fistula. This condition should, except in rare instances, be regarded as a make-shift. The speaker knew of at least four cases in which, after more than a year, death has occurred from complications such as hæmorrhage or from spreading pulmonary gangrene after the patients had been regarded as out of all such danger. In closing fistulæ of this kind it is most important to obliterate the cavity or cavities into which they lead.

THE EVALUATION OF CERTAIN BLOOD-CLOTTING FACTORS IN SURGICAL DISEASE, WITH SPECIAL REFERENCE TO THROMBOSIS AND EMBOLISM AND CERTAIN BLEEDING CONDITIONS

DR. FREDERIC W. BANCROFT read a paper with the above title for which see page 161.

DR. I. NEWTON KUGELMASS, co-author of the paper, by invitation, said that this approach to quantitate the blood substances involved in the clotting mechanism in disease provided a means of determining whether a patient tends to bleed or to clot and hence the ability to diagnose more definitely the hæmorrhagic status of the patient which cannot possibly be ascertained by the present crude clotting time determination. The authors have been able to develop some simple methods of evaluating each of the substances involved in the clotting process, enabling them to characterize the bleeding or clotting tendency of a patient sufficiently in advance to be able to induct therapy in some and thus prevent thrombosis, and in others to overcome bleeding tendencies and make them favorable risks for operative procedure. These methods have been applied to potential hæmorrhagic disease of the new-born in utero by studying the maternal blood, to children suspected as bleeders preliminary to indicated tonsillectomy, to thrombocytopenic purpuras and others with results as indicated by Doctor Bancroft. One of the striking developments of the work is the discovery of a relationship between diet and potential hæmorrhagic disease. The substances involved in clotting mechanism fall into two chemical groups from the standpoint of their nutritional precursors, the prothrombin and fibrinogen are globulins and the blood platelets are lipins. The authors have experimental and clinical evidence of being able to alter the hæmorrhagic status of a patient by diet. Those deficient in the protein or lipin substances were offered diets unusually high in pro-

teins and lipins and *vice versa*. They have thus developed two types of diets, the clotting diet, a regime concentrated in proteins and lipins, and a bleeding diet, consisting essentially of vegetables, fruits and carbohydrates. The indications for the type of diet depend upon the "clotting function index" introduced as a quantitative criterion of the hæmorrhagic status of a patient.

DOCTOR BANCROFT, in closing, said the tests were started on the third and fifth days because he did not know how long ahead the changes in the blood would prognosticate the clotting tendencies. In one of the cases reported the clotting factors were normal on the fifth day and the patient developed a thrombosis on the eleventh, therefore the technic was recently changed and cases are now examined on the fifth and ninth days post-operative. In planning this work it was the original hope—and attempt is still being made—to find a simple technical test that could be done by any technician that will give a patient's clotting or bleeding time. It was due to this reason that the clinical cases have been repeatedly gone over, first with the analysis of prothrombin and then with fibrinogen, but it was not certain that either of these tests gave any clinical indication. Recently in a study of antithrombin it has seemed that perhaps this one test will prove to be an index of a patient's clotting tendencies. In certain cases the installation of a bleeding diet is difficult, and it is hoped that some such drug as heparin may be of service in these patients with clotting tendencies.

In answer to a question about the treatment of phlebitis the treatment suggested by W. F. Shallenberger has been followed as outlined in a paper read before the Southern Surgical Association in 1924. He advised the injection of forty to fifty cubic centimetres of 0.5 per cent gentian violet intravenously. About six cases have been treated by this method. In four there have been quite astonishing results—that is there has been a quick return to normal temperature, pain has ceased almost immediately and the swelling of the limb has apparently returned more quickly than would have occurred without this method of treatment. In one patient in four days the thigh had decreased in size two and a half inches in circumference. No ill results have been experienced by its use. Twice there have been chills, persisting for only a very short time. Doctor Stanley-Brown published an article in the *Surgical Clinics of North America* for August of last year reviewing these cases.

Further it would appear that a patient's clotting tendency can be diminished and therefore diminish the incidence of the disease. Trauma and infection and slowing of the blood stream are definite factors and therefore these factors do produce thrombosis. But some of these patients have all of these factors present and do not develop phlebitis, while others with minimum factors but with probably high clotting indices develop thrombosis. In one of these cases, a woman with a high clotting index developed thrombosis from merely resting her arm on a table. Following the clotting diet her index decreased and her

INTUSSUSCEPTION OF TRANSVERSE COLON

thrombin increased, so that on her return for follow-up, according to the blood examination she had bleeding rather than clotting tendencies

STATED MEETING HELD MARCH 27, 1929

The President, DR FRANK S MATHEWS, in the Chair

NON-MALIGNANT INTUSSUSCEPTION OF TRANSVERSE COLON IN ADULT

DR CONDUCT W CUTLER, JR, presented a man, forty-seven years of age, who was admitted to the Lincoln Hospital on February 25, 1928, complaining of general abdominal pain, vomiting and diarrhoea

Previously in good health, he began about a month before admission to complain of cramp-like pain in the abdomen. This pain was very persistent, was not localized, did not radiate and was not associated with meals. After the onset he was able to continue at work for a week, but then discontinued working because of the progressive character of his complaints. Two weeks before admission he began vomiting about ten to fifteen minutes after meals. The vomitus consisted of food just taken. Up to this time the bowels had been regular, but the stools now became diarrhoeal following catharsis and continued so. Three days before admission the pain became more severe and spasmodic. The vomiting and diarrhoea also became more intense. The stools and vomitus were brown and fluid. The patient had never observed blood in either.

Upon admission the patient was quite prostrated. His temperature was 100, pulse 130. With the exception of a distended abdomen which was everywhere tender, though not rigid, the physical findings were not significant. There was a suggestion of resistance to palpation in the upper right quadrant, and slight rebound tenderness was referred there. The urine was normal. Blood count: white blood cells 14,000, polymorphonuclears 78 per cent.

As the diagnosis was not clear, further investigation was begun after the patient had been relieved of his vomiting by lavage and put on fluid diet. During the succeeding few days, however, the distention, cramps and diarrhoea persisted.

Tests of the stools with benzidine gave consistently positive reactions for blood. There was also considerable mucus in the passages. Gastric analysis was essentially normal in result. The Wassermann was negative. X-rays showed a stomach normal in size and without filling defect or retention. There was practically a stoppage of the barium meal in the ascending colon, the caecum and terminal ileum showing marked distention. Barium enema showed obstruction distal to the hepatic flexure, though incomplete.

The patient was operated upon March 21. Exploration of the abdomen through a right rectus incision revealed a mass in the right upper quadrant. When adherent omentum had been separated from it this mass proved to be an intussusception of the first part of the transverse colon just beyond the hepatic flexure. The mass was about the size of one's fist. The gut wall and surrounding intestinal coils showed evidence of active inflammation. The induration both of the affected intestine and adjacent mesentery was marked. There were several small firm glands in the mesentery suggesting malignant metastasis.

An attempt was made to reduce the intussusception with partial success, about three inches of intussusciens being withdrawn. When this was accomplished the suggestion of any extensive malignancy was much less marked, the gut appearing merely thickened and inflamed. On this account it was decided not to subject the patient to a radical colectomy but to perform a local resection of the Mikulicz type. The affected loop of intestine together with adjacent normal gut and its mesentery was everted and fixed in the usual manner, terminating the first stage.

Three days later the second stage, removal of the everted mass, was performed. A Kocher clamp was introduced to cut down the spur between the parallel lumina of the ascending and transverse colon.

Pathological examination of the removed portion of gut and of its mesentery showed no evidence of malignancy. The firm nodular mass of the gut wall which had formed the apex of the intussusciens showed hypertrophy of the mucosa and marked chronic and acute inflammatory changes with superficial ulceration but no carcinomatous change. The other coats of the intestine showed corresponding pathology.

The patient, relieved of his symptoms, progressed satisfactorily. The spur was cut down joining the lumina and bowel movements began about one week after the second stage. June 6 closure of the persistent fæcal fistula was done. To avoid peritoneal contamination the gut at the site of the stoma was not separated from the abdominal wall, but was tightly closed *in situ* and the muscles and fascia united over it in their normal relations. Healing occurred without leakage, and the patient was discharged two weeks later in good condition. He has been well and gaining in weight since that time.

HÆMORRHAGE FROM MIDDLE MENINGEAL ARTERY

DOCTOR CUTLER presented also a woman, thirty-nine years of age who was admitted to the First Surgical Division of the Roosevelt Hospital December 14, 1928.

Forty-eight hours prior to admission the patient, while standing at the head of the stairs fell without determined cause and was found lying unconscious at the foot of the stairs. This condition of unconsciousness persisted for a few moments. Upon recovering it was noticed that her left arm was held in a peculiar position and seemed weak. She was put to bed and seemed rather dazed, but could be readily aroused. She subsequently improved, but on walking there was noted to be a definite weakness in the left leg while the left arm also continued weak. Twelve hours before admission she lost consciousness completely and her condition had become progressively worse since that time.

When admitted she was in a stuporous condition and tossing restlessly in bed.

Examination of the head showed a moderate hematoma in the right side of the scalp above the mastoid region. The eyes showed contraction of the right pupil as compared with the left and distinct divergent strabismus. The pupils reacted to light, but sluggishly. Ophthalmoscopic examination was difficult because of the constant rolling of the eyes, but there seemed to be some slight haziness in outline of the discs. There was no apparent paralysis of the face muscles and no marked twitching. In her uncoordinated movements the patient used both the left arm and left leg, but muscular resistance in the arm in particular was distinctly weaker than on the right side. The

HÆMORRHAGE FROM MIDDLE MENINGEAL ARTERY

reflexes at the knee were exaggerated, but apparently equal on both sides. There was no rigidity of the neck or Kernig sign.

Her temperature on admission was 100.8° , respirations 32, pulse 78, blood pressure 125/70.

An X-ray picture of the skull did not show a definite fracture at the first examination, but this was not conclusive because of the difficulty in keeping the patient's head quiet during exposure.

A lumbar puncture was done and six cubic centimetres of uniformly bloody fluid was obtained under normal pressure.

Subsequently, upon the day of admission, 150 cubic centimetres of 50 per cent glucose were administered intravenously and there seemed to be some slight improvement on the following morning. During the day, however, the patient became more stuporous and the breathing somewhat stertorous in type, and movements in the left arm and leg were gradually lost, as also was the activity of the face muscles on the left side. Definite choking of the optic discs was now observed and a diagnosis of extradural hæmorrhage with fractured skull and laceration of the middle meningeal artery was made. December 16 the patient was operated upon. She was completely comatose and no anæsthesia was necessary. A button trephine was done over the bifurcation of the anterior branch of the right middle meningeal artery. A considerable amount of clot was discovered beneath the skull extending in all directions in the parietal region. A temporal decompression was then proceeded with and a flap of bone turned down. Its removal revealed a large blood clot perhaps amounting to about six ounces and covering most of the anterior right hemisphere. Active bleeding was coming from the middle meningeal artery and this was temporarily controlled with packing. The clot was removed and the dura beneath found not to have been torn. It was, however, very markedly depressed and the brain tissue beneath it felt very soft and almost fluctuating. Attempt was now made to control the bleeding which apparently came up from the area below the base of the flap. In order to secure the bleeding point the opening was enlarged downward with a rongeur so that the inner table could be inspected all the way to the base of the skull. No definite point of bleeding could be observed, but blood continued to well up from the base in the neighborhood of the foramen spinosum. As no specific bleeding spot could be isolated, a small strip of packing was introduced into this region, which, with moderate pressure, eventually controlled the bleeding. This packing was brought out at the lower angle of the wound anteriorly and flap of elevated bone, muscle and scalp replaced.

Following the patient's return to the ward there was a distinct hyperpyrexia, her temperature reaching 107° . This was associated with marked shock and the blood pressure fell to 70/45. She responded, however, to the treatment employed for shock and by the following day showed distinct improvement. Within twenty-four hours after operation the patient was entirely conscious although a little confused. She was able to use the muscles of the left side, face, arm and leg at this time. During the succeeding days the improvement continued. The slight discharge from the wound subsided following the removal of the packing on the third day. She was allowed out of bed on the twenty-seventh post-operative day feeling entirely well. Since that time the patient has continued in excellent health and has had no symptoms of weakness of the arm or leg and no alteration from her normal mentality.

OSTEOMYELITIS OF JAW

DOCTOR CUTLER presented also a man, thirty-three years of age, who was admitted to the Lincoln Hospital May 26, 1928. Ten days previously he had begun to have pain and swelling at the left side of the jaw. Two days after onset a left lower molar was extracted, and as the swelling did not subside his dentist had made several incisions within the mouth near the site of extraction. The pain and swelling increased, however, and when the patient was admitted there was a tense and brawny induration of the left lower cheek and side of the neck. There was also marked swelling within the mouth, suggestive of alveolar abscess, and from the site of extraction there was a thin purulent discharge. The mouth could be opened but one-half inch.

At this time the patient's temperature was 102°, pulse 106. He seemed very sick and was markedly prostrated. Urine was normal. Blood count: white blood cells 18,000; polynuclears 80 per cent.

On the day following admission an incision was made in an area of softening beneath the ramus of the left jaw and pus obtained. The alveolar abscess was also opened. Subsequent incisions were made as localizations of the process or pocketing occurred. For a period of nearly six weeks the patient's temperature continued of the septic type, ranging from 99° to 103° or 104° daily. During this period several transfusions were given. Blood cultures showed no growth. The patient was so depleted and septic that it was feared he would not survive. The temperature began to subside, however, and by the middle of July had reached normal and the patient was up and about with numerous draining sinuses about the jaw and neck.

At about this time the removal of sequestra from the jaw began. As fragments of the bone became demonstrably loose or were shown by X-ray, they were removed, the sinuses being frequently enlarged for the purpose. This process continued until in October, the total fragments removed approximating a considerable portion of the lower jaw. The sinuses closed until at the present time but one remains discharging. There is at the bottom of this a small sequestrum which requires removal.

On November 17 the patient was discharged to the dental clinic for removal of the dead teeth and splinting of the jaw. From just below the articulations no solid bone was palpable at this time, and in fact for a considerable period of time, while disintegration of the jaw was progressing, there was no stability to the structure. It was assumed that following a dental clearing of the mouth and after an appropriate period for the subsidence of exudate some grafting procedure would need to be attempted.

X-ray pictures which were taken about one month later showed some evidence of bone regeneration. This regeneration has been progressive to the present time, and now has developed a fairly stable bony structure. It is now possible for the patient to use his jaw a little, and he opens his mouth about one inch. The removal of dead teeth and the application of an appropriate dental plate will improve his function considerably.

LARGE RETROPERITONEAL LIPOMA

DR DEWITT STETTEN presented a man, forty-three years of age, who was first seen by him December 5, 1923. He had been examined the week previously for life insurance and a growth was discovered in the lower abdomen. There were no symptoms. The patient had not lost any weight. On examination a large, ovoid, fluctuating mass was felt, filling the right lower quadrant of the abdomen, extending as high as the umbilicus, and somewhat to the left of the median line. It was insensitive and there was no rigidity. It was dull to percussion. The mass felt very much like a large cyst, possibly

STRANGULATED FEMORAL HERNIA WITH GANGRENE

of mesenteric or omental origin. Rectal examination was negative. On catheterizing the patient and emptying the bladder, no effect was noted on the size or shape of the mass. X-ray examination showed no defect in the large intestine, but the cæcum was displaced upward and to the left by the tumor. December 11, 1923, an operation was done. A median incision was made, and a large retroperitoneal, yellowish tumor was found, which had pushed the cæcum upward and inward, and the posterior parietal peritoneum forward so that this had become attached and adherent to the lower leaf of the mesentery of the terminal ileum. There was a small, kinked and twisted appendix with a club-shaped tip, bound down by adhesions between the tumor and the cæcum. The tumor was distinctly encapsulated and obviously lipomatous in character, springing apparently from the retroperitoneal fat in the region of the brim of the pelvis near the right sacro-iliac joint. There was a lobulated prolongation posteriorly

near the upper pole. The tumor was enucleated without much difficulty by splitting the posterior parietal peritoneum over it, and then dividing the capsule of the tumor. It was moderately adherent at the lower pole and at the lobulated prolongation posteriorly near the upper pole. There was very little bleeding. The appendix was removed in the usual fashion. The tumor (Fig 1) measured twenty-two centimetres in length, twelve centimetres in width, and nine centimetres in thickness, and weighed 710 grams. It was encapsulated and there was a small lobulation of the upper pole posteriorly. It was rather firmer and more fibrous than the usual lipoma. On microscopic examination the tumor was found to be an ordinary lipoma, composed of mature fat cells, with no suggestion of malignancy. The convalescence was uneventful and the patient has remained perfectly well since.

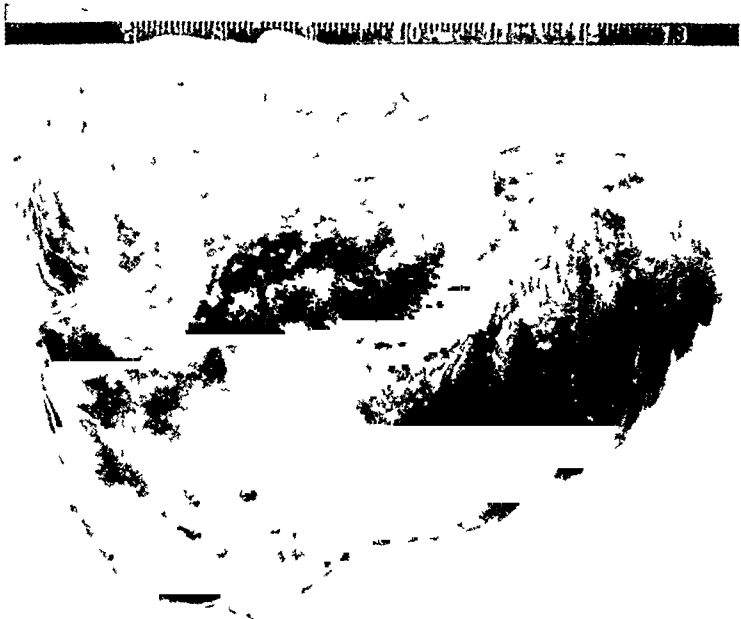


FIG 1—Large retroperitoneal lipoma

STRANGULATED FEMORAL HERNIA WITH GANGRENE OF ILEUM IN SEVENTY-NINE YEAR OLD PATIENT

DR DEWITT STETTEN presented a woman, eighty years of age, whom he first saw on October 15, 1927. For twenty-five years the patient had had a hernia in the right groin, which had always been reducible, and which never had been previously incarcerated. A truss had been worn until five years ago. About twenty hours previously patient developed abdominal cramps and vomiting which continued in spite of an effective enema. About three hours before Doctor Stetten's examination, she noticed that the swelling of her right groin had become irreducible. The examination disclosed a hard sensitive globular swelling in the right groin, the size of a small orange. It was irreducible and tympanitic on percussion. The patient's condition was good. The temperature was normal. The pulse was 80, regular and of good

quality The presence of a right strangulated femoral hernia was evident The patient was immediately transferred to the hospital and operated upon under local anæsthesia In the hernial sac was found a four inch loop of ileum, dark bluish-black in color In spite of about twenty minutes' nursing with hot saline wipes, there was only slight improvement in the appearance of the strangulated loop, although the peritoneum was glossy and there appeared to be some peristalsis It seemed rather certain that the loop would not recover, but owing to the patient's age a primary resection was deemed inadvisable The loop was therefore drawn out on the abdominal wall until undoubtedly healthy intestine protruded beyond the peritoneal cavity, gauze tampons were packed around the loop The patient ceased vomiting immediately upon the relief of the constriction After the lapse of nineteen hours examination showed advanced gangrene of the strangulated loop The patient was again operated upon under nitrous oxide-oxygen-ethylene anæsthesia The tampons were removed and the healthy ileum brought further out into the wound Deliberate resection with a lateral isoperistaltic ileo-ileostomy was performed in the usual manner The anastomosed portion of the intestine was then replaced into the abdominal cavity, a modified Lotheissen femoral-inguinal hernioplasty was done according to the method described by the author The patient's convalescence was entirely uneventful and the wound healed by primary union

Doctor Stetten presented this case to demonstrate a plan of procedure in strangulated hernia with intestinal gangrene in the aged, which he believed to be worthy of commendation By dividing the constriction, the intestinal obstruction and shock are relieved The danger of primary resection, with intestinal anastomosis and hernioplasty is certainly reduced by performing this operation after an elapsed period of time, during which the patient has had some chance to recover This method is certainly preferable and without much greater risk than the usual procedure of removing the gangrenous gut that has been brought into the wound, leaving the resultant ileostomy for subsequent closure and then performing a secondary hernioplasty

DR HOWARD LILIENTHAL said that in hernia when gangrene is present, even though the constriction has been removed, the process may after all be progressive and there may be spots of gangrene quite a distance from the primary necrotic area Consequently, to avoid danger, he preferred to cut off that loop of the gut as soon as possible He has used a method exemplified in the following case A little, thin, old woman had strangulated hernia with gangrene of the ileum Doctor Lilienthal enlarged the opening, withdrew the gut until practically certain that nothing was left within of the gangrene, placed half a Murphy button into each side of the loop through an opening in the gangrenous part, made a minute incision over the stem of each button and forced the two together No suture was necessary, overlapping or otherwise The walls of this gut were thin The strangulation was so acute that there was no hypertrophy of the gut walls He crushed the gut walls the same as he is in the habit of crushing the root of the appendix, ligated over the place where the clamp had crushed the two legs of the loop about an inch and a half away from the Murphy button, which was now closed, and insured immediate passage of gas and liquid stool, cut the ileum

STRANGULATED FEMORAL HERNIA WITH GANGRENE

off and carbolized the stumps thoroughly. The silk ligature was left with its ends in the wound and the remainder of the hernia was pushed back far enough to make sure it was in the abdomen, strapped there and left. It was seven or eight days before the ligature came away with the stump and there was at no time leakage or other trouble. The button came away in due time and the patient was entirely cured. In feeble, vomiting, old individuals, when one wishes to finish the operation as quickly as possible, this is a good method and there is as little danger connected with it as there is in any other procedure with the same object. Contact has been established, not only the gangrenous loop has been gotten rid of but the unhealthy tissues intimately connected with it. The danger point is near enough to the opening in the abdominal wall so there need be no fear if there should be some accident at the point where the ligature was applied.

DR RICHARD LEWISOHN referred to a patient whom he had presented before this Society in 1926. He had operated on the man in 1920 for strangulated inguinal hernia of six hours' duration. The patient was eighty-two years of age at the time of operation. Parts of the transverse colon were completely gangrenous and he performed a primary resection. The man, aside from pneumonia, made an uneventful recovery. These old people, when they are in good general condition such as absence of marked pathology in heart, lungs or kidneys, are not very grave operative risks. In view of the fact that Doctor Stetten was doubtful as to the viability of the strangulated intestine, "vorlagerung" was the correct procedure. In the presence of definite gangrene, primary resection would be preferable to a two-stage operation.

Doctor Stetten in closing said that he had presented this case just because he thought it illustrated the value of not doing a primary resection in these cases. It is true that at the time of the first operation he was slightly doubtful of the condition of the gut and that he thought that there was a possibility that it might recover. Nevertheless, he believes that even if the certainty of gangrene is present it would be advisable to follow this procedure and not do the resection until a later date when the patient has recovered somewhat from the shock and obstruction after the constriction has been relieved. He thinks that by this means the risk of operation and the mortality might be reduced. Although his patient was in good condition at the time of the first operation and might have stood a primary resection, she ceased vomiting immediately after the release of constriction and was in still better condition at the end of the nineteen hours when the resection was performed.

As to the possibility of gangrene extending further along the intestine, in this case this was out of the question, as the ileum was brought out on the abdominal wall well beyond the gangrenous area. He felt that this danger could easily be overcome and that there was no particular need for worry about absorption from the loop of extra-abdominal intestinal gangrene when well walled off by tampons and only left for a relatively short period of time. A similar situation is frequently met with in the Mikulicz "vorlagerung"

operation where the mesenteric vessels must be ligated. Here there is never any trouble provided the gangrene which follows the arrest of the circulation is entirely extra-abdominal.



FIG. 2.—Radiograph twenty four hours after motor meal showing arrest of meal in right side of transverse colon.

SUBMUCOUS LIPOMA OF TRANSVERSE COLON WITH RECURRENT INTUSSUSCEPTION

DR DEWITT STETTEN presented a woman, forty years of age, who first came under his observation February 5, 1929. She gave a history of having had during the previous seven weeks repeated attacks of severe cramp-like abdominal pain with rather vague localization. The pain apparently started somewhere in the left lower abdomen and radiated all over the abdomen, to

SUBMUCOUS LIPOMA OF TRANSVERSE COLON

both shoulder blades and down the inner side of the left thigh. The patient belched frequently and vomited at times during the attacks. The bowels were constipated and occasionally there was mucus in the stools but never any



FIG 3—Radiograph after barium clyster showing sharply outlined, smooth, oval defect in right side of transverse colon

blood. There had been no jaundice nor urinary symptoms. In the past four months, the patient had lost about fifteen pounds in weight. The patient was a well-nourished woman who did not appear acutely ill. The abdominal examination revealed no masses, sensitiveness nor rigidity. X-ray examination showed that the motor meal was definitely arrested in the twenty-four-hour film at a point just to the right of the midtransverse colon. The intestine was not dilated (Fig 2). The barium clyster the following day disclosed a persistent, sharply outlined, smooth, oval defect about the size of a

large egg in the right half of the transverse colon. Although this defect shifted slightly in the films, it appeared to remain in relatively the same position. It seemed to be free at its left side, but apparently fixed to the right



FIG 4—Radiograph after defecation following barium clysis showing retention of barium in appendix, cæcum, ascending colon and right side of transverse colon with relative emptying of balance of large intestine

(Fig 3) This was confirmed by fluoroscopy. After defecation the portion of the colon distal to the defect emptied relatively well, while that proximal remained quite filled. (Fig 4) A second barium clysis given two days after the first again showed the oval defect very distinctly. It had moved somewhat further over to the left and on this second examination the clysis

SUBMUCOUS LIPOMA OF TRANSVERSE COLON

seemed to be almost completely obstructed at the defect. The slight amount of barium proximal to the defect was apparently retained from the previous motor meal and the previous clyster (Fig 5). As a result of the X-ray

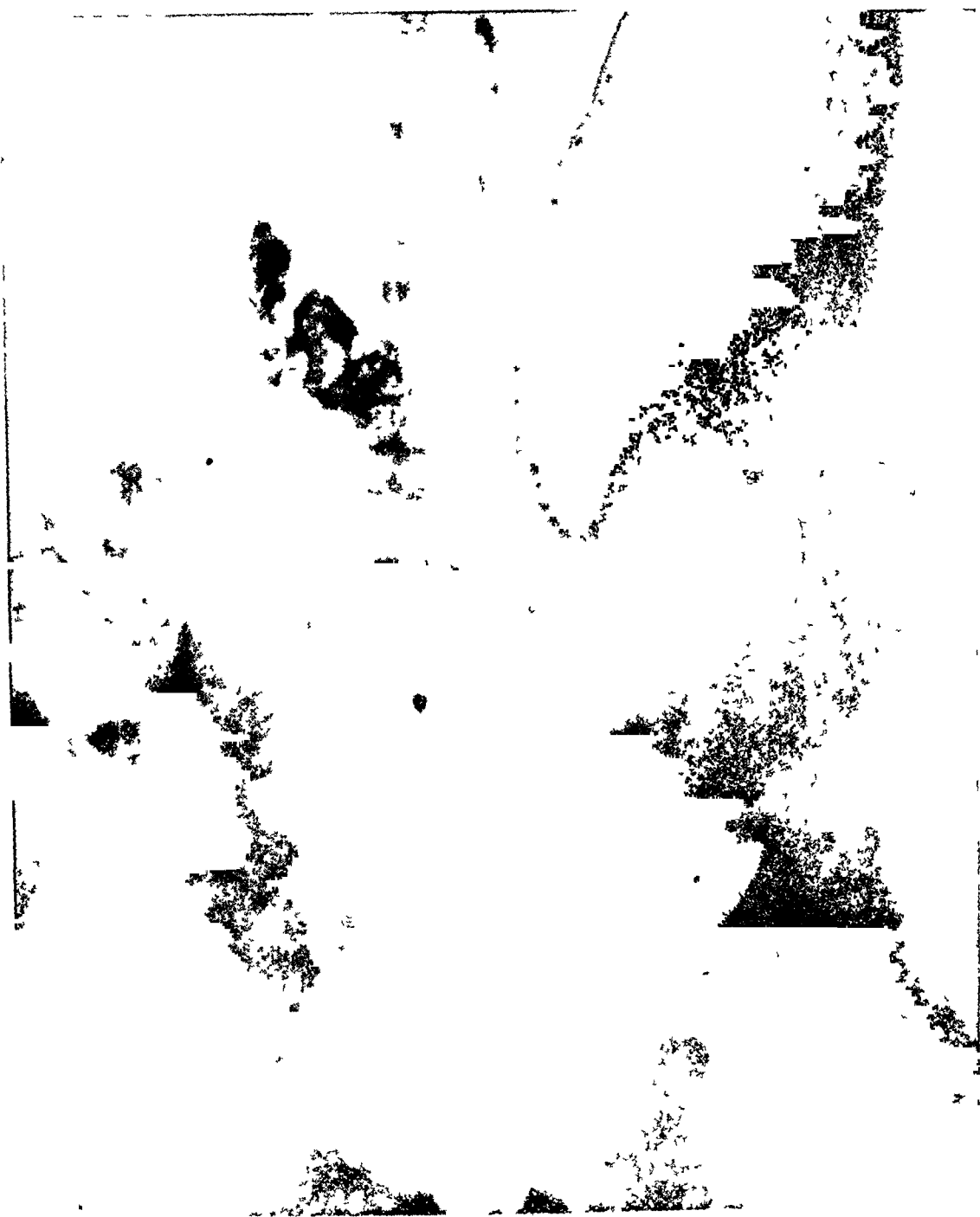


FIG 5—Radiograph after second barium clyster showing almost complete obstruction near mid point of transverse colon and persistence of oval defect. Slight amount of barium in right side of transverse colon, ascending colon, cecum and appendix due to retention from previous motor meal and previous clyster.

studies a diagnosis of pedunculated benign tumor of the right side of the transverse colon with partial intestinal obstruction was made. It was thought that the tumor was probably a submucous lipoma and that the attacks of pain and vomiting were attacks of partial obstruction due either to simple obturation from the tumor or more likely still to recurrent intussusception.

The patient was operated upon February 7, 1929 under general anæ-

thetia Through a median epigastric incision the transverse colon was drawn into the wound, and in its right half, exactly in the position indicated by the X-ray, was found a smooth, firm, freely movable, ovoid pedunculated tumor, the size of a large egg, attached by a broad pedicle to the lower posterior wall of the gut. There was considerable infiltration around the base and the adjacent mesentery, where there also could be felt numerous enlarged, hard lymph glands. As the tumor had the characteristic feel of a benign growth, it was assumed that this infiltration and the enlarged, hard lymph glands were due to an inflammatory reaction, possibly because of a recurrent intussusception which had reduced itself spontaneously. A transverse incision was made through the upper posterior wall of the colon. The tumor was found to be



FIG. 6—Subcutaneous lipoma of transverse colon with gangrene and ulceration of mucous membrane of free half (to left)

in the submucous layer and had all the gross characteristics of a benign growth. The mucous membrane over the free half of the tumor was gangrenous and ulcerated. The pedicle was circumcised at its base and the tumor excised, the mucous membrane defect being closed with a double row of sutures. The colotomy wound was closed in the usual manner by a triple layer of sutures without narrowing the lumen of the gut. The omentum was laid over the suture line and sutured in place. The abdomen was closed by the usual method without peritoneal drainage. The patient's convalescence was entirely uneventful, the wound healing by primary union except for a slight subcutaneous sup-

puration at the lower angle, through the skin drainage opening which rapidly cleaned up. She has been free of symptoms since the operation.

The tumor was a smooth, firm, ovoid mass the size of a large egg, covered by mucous membrane of which the apical half was gangrenous and ulcerated. This gangrene and ulceration may have accounted in part for the infiltration of the mesentery and the apparently inflamed mesenteric lymph glands. On section it was found to be a rather firm, fatty growth, characteristic of a submucous lipoma.

The case is presented mainly to show that it is possible today, with the aid of careful X-ray studies, to make a pre-operative diagnosis of this relatively rare condition. Twenty years ago, Doctor Stetten, on the basis of two personal cases, published a paper entitled, "The Submucous Lipoma of the Gastro-intestinal Tract" (*Surgery, Gynecology and Obstetrics*, August,

RADICAL AMPUTATION OF BREAST FOR CARCINOMA

vol ix, pp 156-175, 1909) In this paper he made a complete analysis of the literature up to that time and found that seventy-seven cases had been reported from all portions of the gastro-intestinal tract, of which thirty-four were in the colon, excluding the rectal cases In fifteen of these an intussusception occurred—nine chronic and six acute It is curious to note that in this paper there is no reference whatsoever to X-ray studies as a diagnostic measure Of course twenty years ago the radiographic study of gastro-intestinal lesions was in its infancy, and although studies of the stomach were beginning to be made, the intestine was still considerably neglected for a number of years When the paper was published, a definite, correct, pre-operative diagnosis was regarded as an almost impossible achievement As a result of the strides that have been made in intestinal radiography in the past years it must be admitted that the exact diagnosis in this case was neither fantastic nor difficult, but rather obvious Its mobility definitely suggested the pedunculation and even the probable pre-operative diagnosis of the pathology of the tumor was not so far-fetched, as it is well known that the submucous lipoma is by far the most common form of benign growth in this region

DR JOHN DOUGLAS said there were two reasons perhaps why correct diagnosis in this case had been possible One, that Doctor Stetten had had a similar case before and that helps in making a diagnosis of rare conditions The other, that it was a submucous tumor These lipomata of the large intestine are not always submucous Some two or three years ago Doctor Douglas said he had shown before the Society a case of lipoma of the large intestines The tumor was not pedunculated in this case An X-ray of the colon was taken In the radiograph the shadow was exactly that which would be shown by a carcinoma and it was not until a section of the sigmoid had been removed and an anastomosis done and the gut cut open afterward that the fact that it was a lipoma rather than a carcinoma could be recognized

DR FRANK S MATHEWS recalled a case with pelvic tumor well circumscribed and suggesting an ovarian cyst It was, however, attached to the wall of the pelvis At operation it proved to be a lipoma, for the most part easily enucleated, but it extended downward and evidently had its origin in the femoral canal

DR HERMANN FISCHER said that these retroperitoneal lipomata are sometimes of tremendous size Although they are benign tumors they have the tendency to recur There are on record several of these tumors that have recurred two and even three times They are potentially malignant as they can endanger the life of the patient by their huge size and the difficulty of their removal Every case of retroperitoneal tumor ought to be carefully watched for possible recurrence

RADICAL AMPUTATION OF BREAST FOR CARCINOMA AFTER CLOSURE OF LARGE DEFECT

DR DEWITT STETTEN presented a woman forty years of age whom he first saw March 15, 1928 She had noticed a growth in her right breast for nearly a year This had been growing rather rapidly for about four months

Examination disclosed a large, irregular, hard tumor in the outer upper quadrant of the right breast extending toward the axilla. The tumor was firmly and broadly adherent to the skin, and in the axilla several large, hard lymph glands could be palpated. The patient was operated on March 21, 1928, the usual radical amputation of the breast being performed. Owing to the extensive skin involvement, a very wide skin excision was necessary, especially laterally, so that there was an extremely small axillary flap left and a very large resulting defect, which, even with extensive undermining and mobilization of the skin of both sides, could not be closed. Instead of doing a Thiersch graft on this defect which has the disadvantage of leaving a very thin, delicate scar directly over the ribs, lateral crescentic incisions were made on each side some distance away from the wound edge to relieve tension. After this was done the main wound could be easily closed without tension and the gaps produced by the lateral crescentic incisions were tamponed with gauze. The patient made an uneventful convalescence and the sutured portion of the wound healed by primary union, both medial and lateral flaps maintaining excellent nutrition. The gaps produced by the lateral incisions granulated nicely and on April 9, 1928 these granulating areas were successfully Thiersch grafted. Doctor Stetten presents this case to demonstrate what he considers a practical method of closing large defects after radical amputation of the breast. The scar from the main wound is a linear one, and there is a normal skin covering over the ribs. Function of the arm was rapidly restored almost to normal except for a slight restriction to backward motion when the arm is elevated. Doctor Stetten believes that this method is superior to the grafting of the original defect as it leaves a normal skin covering with its pad of subcutaneous fat over the anterior and more exposed portion of the chest and in no way increases the disturbance of function of the arm. Of course the Thiersch grafting of the lateral gaps could be done as a primary measure. This perhaps may even be more advisable than doing it as a secondary procedure, as was done in this case.

DR RICHARD LEWISOHN said that the Kocher incision as used by Doctor Stetten, required plastic surgery in a large number of cases. With the Stewart incision, which is now the incision of choice of a number of surgeons at Mount Sinai Hospital, the skin can always be sutured without undue tension and without resorting to plastic correction. For this reason, the Stewart incision, aside from its better cosmetic effect, is preferable to the Kocher incision.

DR ALEXIS MOSCHCOWITZ said that personally he objected to the Stewart incision for a radical amputation of the breast. When he heard Doctor Stewart read his paper describing the new incision, he was the first one to use it, but after trying it out on a few cases, he abandoned it. While cosmetically, very beautiful, he has never had as perfect an exposure as with the ordinary incision extending a short distance down the arm, on that account, he is afraid of being less radical than with the ordinary incision.

HERNIA THROUGH THE FORAMEN OF WINSLOW

DR JOHN DOUGLAS presented a man, fifty-three years of age, who had an attack of severe pain during the night of October 26, 1927. The pain began in the region of the navel and then located in the epigastrium. He vomited for four hours that night and the most severe pain was then relieved.

He was admitted to St Luke's Hospital on the morning of October 27. There was no elevation of temperature or blood count, no rigidity or loss of liver dulness, and only moderate tenderness in the epigastrium.

The following day the radiographs showed quite obviously a displacement of the pylorus and duodenal cap to the left with a defect along their right margins (see Figs 7, 8, 9), and a loop of small intestine which apparently had passed through the foramen of Winslow into the lesser sac. At the end of six hours the stomach was emptied, but the shadow of this loop of small intestine could still be seen, distended with gas, occupying the same

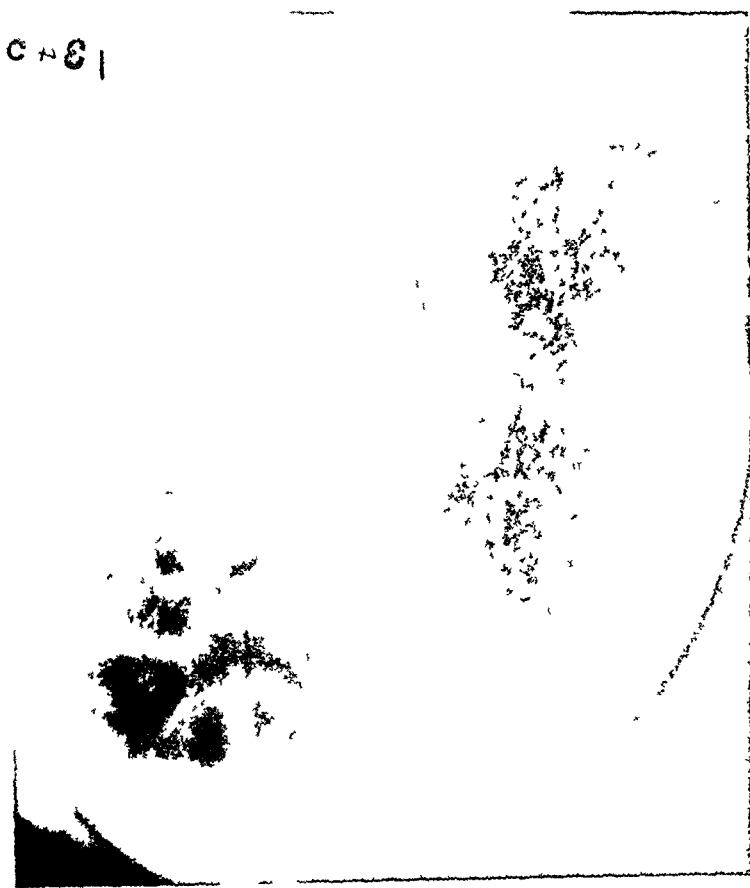


FIG 7—Hernia through the foramen of Winslow five minutes after barium meal. Note deformity of pylorus and duodenum and loop of small intestine in lesser sac.



FIG 8—Hernia through the foramen of Winslow six hours after meal. Note air-filled loop of small intestine in lesser sac continuous with barium-filled loop below.

location and well above the transverse colon which was outlined by the bismuth filling it. This was also shown, but less plainly, in a twenty-four-hour film. Therefore, a diagnosis was made of hernia through the foramen of Winslow.

Operation was performed the following day, there being no obstruction apparent in this loop of small intestine. At the time of operation no intestine was found occupying the lesser sac. However, a loop of ileum, ten inches long and about two feet from the ileocaecal valve was found at both ends of which could be easily demonstrated a narrow compressed area completely encircling the in-

testine and extending well down into the mesentery, such as one sees in a loop of intestine which has been pulled out of a hernial sac after it has been pinched by the margins of the ring. The foramen of Winslow admitted three fingers. As a later radiograph showed the absence of this shadow, it would appear from the evidence present that this loop of intestine had been herniated through the foramen of Winslow into the lesser sac.

It being impossible to narrow the foramen of Winslow on account of its surrounding structures and as the loop of intestine had apparently passed either to the right of the hepatic flexure or in front of the transverse colon,



FIG 9—Hernia through the foramen of Winslow. Twenty four hour film. Note air filled loop above colon.

an attempt was made to prevent a recurrence of the lesion by causing adhesions between the greater omentum and anterior abdominal wall, so that the small intestine could not again pass in front of the transverse colon. Since the time of operation, seventeen months ago, the patient has had no recurrence of his symptoms.

In May, 1924, the speaker reported a case of hernia through the foramen of Winslow in the *Journal of the American Medical Association*. At that time there had been collected by Ullman thirty cases from the literature.

My case then recorded was the thirty-first case in the literature and the third case in the American literature. Since then a number of cases have been reported, one series by Dewis and Miller, who added to Ullman's group one case of their own and two additional cases not reported by Ullman, making a total of thirty-three cases, not including the case previously reported by me. In a rather superficial search of the literature since then, I have found three additional cases reported—one by Shapiro, one by Carling and Smith and one by Green. These, together with the case here reported and the one previously reported by me, make a total of thirty-eight cases.

The excellent articles and a review of the literature published by Dewis and Miller, and also by Ullman, make it unnecessary to again go through this part of the subject. However, while it is recognized that the occurrence of a hernia through the foramen of Winslow usually causes symptoms of acute strangulation and necessitates immediate operation, it was the disappearance of these acute symptoms which made possible the radiographic

examination in this case which allowed a diagnosis to be made, which would of course, be impossible in the presence of acute symptoms. As it is stated in one article on the subject that a diagnosis of this condition has never been made before operation and rarely even suspected, it seemed worth while to report this case in which the diagnosis was made previous to operation, for although the intestine was not found in the lesser sac, there was ample evidence of its having been there at the time the radiograph was taken.

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ENDOMETRIOSIS OF THE SIGMOID—INTESTINAL OBSTRUCTION

DR. JOHN DOUGLAS presented a woman, forty-four years of age, who was in good health until September, 1928, when she had an attack of abdominal pain with distention. Bowels moved only with repeated enemas. This attack was followed by obstinate constipation and considerable loss of weight. October 24, she had another attack of severe and acute abdominal pain with passage of a small amount of gas and feces only effected by enemas, colonic irrigations and the use of pituitrin. The patient vomited and presented all the evidence of an obstruction of the sigmoid. At no time was there any blood in the stools. A barium clyisma verified the diagnosis of obstruction in the sigmoid flexure.



FIG. 10.—Endometriosis of sigmoid. Tumor incised and laid open.

November 1, the first stage of a Mikulicz operation was done with resection of the growth and about twelve centimetres of intestine. The protruding ends of the intestine were left clamped after suturing the proximal and distal limbs together to establish a spur. The tumor (Fig. 10) causing the obstruction of the intestine was 2.75 centimetres in diameter and was situated in the mesenteric side of the sigmoid. There was no ulceration of the mucosa. For this reason, it appeared that the growth was not a carcinoma. A Mikulicz clamp was applied to the spur on the sixth day following operation and the colostomy closed November 21. The patient was discharged December 8 eighteen days later.

The pathological examination showed the tumor to be made up of endometrial tissue

In 1893 Von Recklinghausen discussed endometrial adenomata and suggested that they might arise from embryonic rests derived from the Wolffian body. Since then, many cases have been reported in the medical literature of endometriosis occurring primarily in the abdominal wall or in post-operative scars, following operations on the uterus or adnexæ. They have been reported as occurring in the rectovaginal septum, in the peritoneum, particularly in the pelvic peritoneum, and in the wall of the intestine. The pathological records of St. Luke's Hospital, beside the case here reported, show two of the appendix, one of the small intestine and one occurring in an abdominal scar.

Much interest in the subject has been stimulated during the past few years by the work of Samson, whose report of cases, together with the experiments of his co-worker, Jacobson, has been particularly directed to the implantation theory of origin. According to Samson's belief, peritoneal endometriosis arises from endometrial epithelium passing out from the patent tubes into the peritoneal cavity. It is believed by others accepting the implantation theory, that the origin of the endometrial tissue is from the ovary. In the case here reported it is difficult to assume the implantation theory for its origin, as the tumor was situated in the intestinal wall well below the peritoneal coat, and the theory of an embryonic rest would better explain its origin.

OSTEITIS FIBROSA OF TIBIA

DR. JOHN DOUGLAS presented a boy, seven years of age, who was admitted to St. Luke's Hospital October 26, 1927. Three weeks before admission, he fell and struck the anterior aspect of his left tibia on a stone. It hurt him for a day or so but caused no abrasion and there were no further symptoms until one week later when his mother noticed a swelling in this area which was at this time neither red nor tender. A radiograph showed an area of rarefaction at the junction of the upper and middle third of the tibia. This was curetted out after chiseling off the anterior surface, and a fragment of the cortex, after carefully removing all of the endosteum, was inserted as a graft. The cavity entirely filled in after several months as shown by a series of radiographs taken over this time.

He was readmitted to the hospital January 30, 1929, fifteen months after the original operation. In the interval he had been free of pain, except for an occasional ache in the leg in wet weather, until the day before his admission when he had a sharp pain slightly higher than the original area. A radiograph at this time showed the original area occupied by the cyst, now filled in by dense and compact bone, and the outline of the original graft could still be distinguished. Just above the original lesion, however, there was again shown a rarefied area which extended about 2.5 centimetres above the old lesion.

January 31, the bone was again chiseled away from the surface of this area which was the site of a lesion similar to the one that had occurred before. There was no cyst but there seemed to be two distinct areas in the pathological process, one of which was occupied by a dense, fibrous tissue, the other showing considerable calcification with the formation of new bone.

FRACTURES FROM OSTEITIS FIBROSA OF HUMERUS

This area was again chiseled out and filled with chips of bone removed from the cortex, which were carefully scraped so as to remove any endosteum or any bone which appeared diseased. He has again healed up and a radiograph taken a few days ago shows considerable calcification and regeneration in this area.

The patient was shown to demonstrate a repair of the original area of osteitis fibrosa by means of curetting together with insertion of a graft and the development of a new area of the same process above and apparently continuous with the old lesion.

FRACTURES FROM OSTEITIS FIBROSA OF HUMERUS

DR JOHN DOUGLAS presented a boy, thirteen and a half years of age. Four and a half years ago, June, 1924, he was struck on the right arm with some school books swinging on a strap. This caused a fracture of the upper third of the humerus. The fracture healed with deformity, and three months later, September, 1924, was refractured. He was told later that a bone cyst was present and an operation was advised. The bone was curetted in April, 1925, and in September, 1925, it was stated that he had a third fracture after a comparatively trivial traumatism. Since then he has had a number of X-ray treatments with moderate voltage of 100 to 130 kilovolts. March 1, 1929, while throwing a baseball, he again fractured his right humerus. This time the fracture, which was a spiral one, (Fig 11) apparently started below the area shown by the X-ray to be occupied by the bone cyst which involved somewhat more than the upper half of the humerus, extending above almost to the epiphyseal line. The whole shaft, however, involved in the line of fracture appears rarefied. Doctor Douglas desired advice as to the line of future treatment after the healing of this fracture, as it would appear, in view of his operation and four fractures, that any operative procedure for the curetting and removal of the diseased area, together with the application of a graft, would necessarily be a very extensive one and would involve considerable danger of injury to the musculospiral nerve.

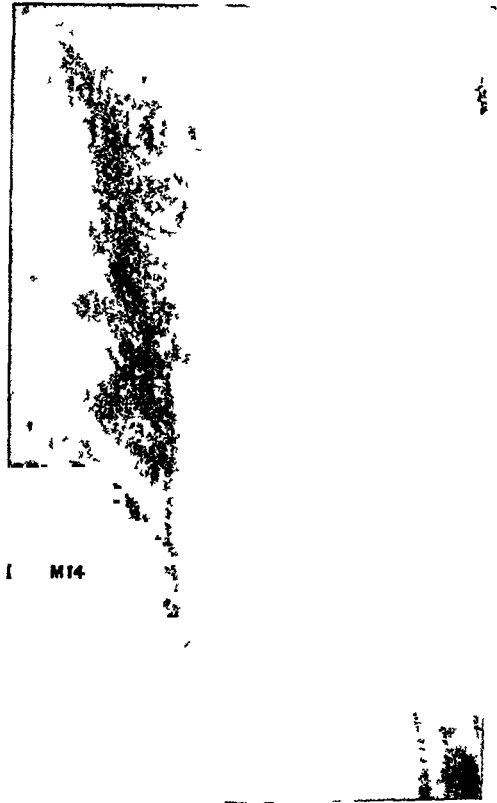


FIG 11—Case IV—Osteitis fibrosa cystica
Pathological fracture

DR ROBERT T MORRIS said that although he would not like to take the responsibility of advising a certain experimental method, yet if this young man were willing to do without the use of the humerus for a year, the entire diaphysis of the humerus might be removed, leaving the periosteum. He would probably get regeneration from the periosteum and eventually have new, healthy bone.

DR MORRIS K SMITH said that he had had occasion to treat a girl of eleven for her third pathological fracture of the upper end of the right femur. The underlying condition was osteitis fibrosa. He examined this patient about

ten years later. She had had no subsequent fractures. There was marked shortening of the extremity. Doctor Douglas had called attention to the apparent new bone formation in the cyst in his case and Doctor Smith wondered whether an eventual cure as far as strength of the arm was concerned might not be anticipated if the patient were not operated upon.

DR HERMANN FISCHER said that many years ago he observed a case, together with Dr. Frederick Kammerer, of an extensive osteofibrosis which had its seat in the diaphysis of the femur. The femur consisted of a mere shell of bone with a complete fibrosis of the cancellous tissue from the greater trochanter down to the condyles. The man had suffered a pathological fracture in the middle of the femur which was the first symptom of the disease in this case. All the diseased tissue in this case was removed. The man finally left the hospital with a consolidated fracture and a useful leg. He thought Doctor Douglas' case should be operated upon. One need not fear an injury to the musculospiral, if it is carefully dissected and held out of the way.

DR DEWITT STETLEN said that he had presented a similar case involving the femur before this Society November 12, 1919.

The patient originally came to him about nine and a half years previously with a fracture of the neck of the femur. X-ray examination showed a condition that looked like a cyst involving the neck, greater trochanter, and upper part of the shaft. This was originally treated conservatively, but as the rarefaction increased operation was eventually decided upon and performed, and a tumor-like mass was removed which consisted largely of undifferentiated osteoid or chondroid tissue with cartilaginous islands of various size. He made a good recovery and was well for about six and a half years when he developed a recurrence. The process subsequently extended down the shaft of the femur and required a second operation, from which he also made a satisfactory recovery. About nine months later he sustained a fracture of the neck of the femur and six months after that a transverse fracture of the shaft. Both of these fractures united satisfactorily and since that time he has had no further trouble.

DOCTOR DOUGLAS in closing said that regarding the X-ray treatment of these cases he had seen two cases where radiotherapy had been used, one involving the lower end of the radius, the other located in the femur. The one in the radius has been quite successful and has markedly diminished in size. The one of the upper end of the femur is considerably improved. The last patient presented here has been treated for a year and a half and Doctor Douglas said he believed re-operation would be necessary as the X-ray appears to have done little good. He had asked for an expression of opinion as to the advisability and danger of operating in this case as the process apparently involved most of the shaft of the bone, there had already been three fractures and one operation, and because the danger of injury to the musculospiral nerve was particularly great in view of the changes resulting from the conditions which had gone before. It seems, however, that the prognosis without operation justifies this risk.

SUBPHRENIC ABSCESS

SUBPHRENIC ABSCESS

DR THOMAS H RUSSELL presented a man, thirty-eight years of age, who was admitted to the Post-Graduate Hospital October 25, 1921. He was operated upon for a perforated duodenal ulcer by Doctor Russell during the month of March, 1921. After the operation he made a satisfactory recovery and felt exceptionally well, gained forty pounds in weight and was not troubled with symptoms of stomach trouble, which he had suffered from for a long time before the operation. He remained well until six weeks before his reception into the hospital when he suddenly began to have pain in the upper right abdomen. The pain was stabbing and very severe, and was not influenced by food. He began to lose weight rapidly. Three or four days ago the pain became very severe and was much worse after taking food. No nausea or vomiting. He has had an irritating cough for several weeks. Pain is very severe when he coughs.

The chest examination is negative. There is muscular rigidity and a sense of fulness in the right upper quadrant of abdomen. Tenderness is present when the ribs are tapped over the right lower chest.

The X-ray showed subphrenic abscess. (The films have been destroyed.) With gas-oxygen anæsthesia an incision was made in the right upper quadrant of abdomen parallel to right rectus muscle, just as incision ordinarily used for gall-bladder operations.

Abdomen opened and explored. A large abscess was found in front of and above the liver extending down over the margin of the liver. With finger dissection the abscess was opened and pus removed by means of suction. Two rubber tube drains were inserted and wound closed with silkworm sutures. Patient made an uneventful recovery and was discharged from hospital November 23, 1921. He has been in excellent health since.

DOCTOR RUSSELL presented a second patient, a man, thirty-five years of age, who was admitted to hospital July 25, 1919. He had suffered from pain in his right upper abdomen since the preceding July 12, on which date he was struck on the right side of lower chest and upper abdomen by a falling spring iron. There was severe pain at the time which subsided somewhat in a short while. The next day pain became worse and has gradually increased in severity. He has noticed fulness over right lower ribs. He coughs a great deal but cannot get relief by coughing. Cough is very painful.

Examination of chest negative. There is a decided fulness with tenderness and rigidity over the right costal margin and in epigastrium. Increased liver dulness which extends up to the third rib. There is sense of increased heat over right upper abdomen and over swelling in right lower chest.

Operation under gas-oxygen anæsthesia. Incision parallel to right costal margin down to peritoneum. Peritoneum stripped downward and fingers gradually inserted into abscess cavity extending above liver and below diaphragm. A large amount of thick yellow pus evacuated. Not foul in odor. Two rubber tube drains inserted. Dry dressing applied.

Culture Report—Specimen shows numerous pus cells with irregular pieces of tissue about eight millimetres thick and resemble echinococcus cyst formation.

Microscopic—Cyst wall shows hyaline lamellar structure of concentric rings similar to echinococcus cyst but no parasite found. Discharged September 30, 1919.

DOCTOR RUSSELL presented also a man, thirty-five years of age, who was admitted to hospital June 30, 1921, complaining of pain in his epigastrium. The man had had pneumonia seven years ago on left side. He was operated

upon by Doctor Deaver, in Philadelphia, seven months ago for intestinal obstruction, a colostomy being performed in left side at that time. He was thought to have cancer of the bowel which proved to be inflammatory, then colostomy was closed. Six weeks ago was operated upon by Doctor Russell in the Post-Graduate Hospital for intestinal obstruction and general peritonitis—obstruction due to a band—no perforation found after careful search. Peritoneal cavity washed out with saline and drained. Patient in very poor condition. Prognosis bad. The man improved after this last operation but had a stormy convalescence. Was discharged from hospital eighteen days later in good condition.

Readmitted to Post-Graduate Hospital June 30, 1921, complaining of pain in right upper quadrant of abdomen referred to back and right lower chest. Nausea but no vomiting. Is losing weight rapidly and cannot eat. Feels very weak.

Physical examination reveals numerous râles in right lower base. Tenderness over liver region and right upper quadrant of abdomen. X-ray shows right diaphragm elevated and flattened with obstruction of the costophrenic angle. Absent illumination is seen at right base, this having a cup-shaped appearance bounded above by a straight line with a definite wave suggesting a hydropneumothorax, this probably encapsulated. The quantity of fluid is estimated at about a pint. Blood count 14,400, with 88 per cent polymuclear cells, temperature 101°, pulse 118. Under nitrous oxide anaesthesia an incision was made in right upper quadrant of abdomen. A large subdiaphragmatic abscess was found on the right side. Abscess extends from upper surface of right lobe of liver to the suspensory ligament, then follows down to under surface of liver. Opened with fingers. Pus removed by suction. Rubber tube and cigarette drain inserted. Wound closed with silkworm gut. Pus shows pneumococcus. Patient discharged August 8, 1921.

SUBPHRENIC ABSCESS WITH SPECIAL REFERENCE TO TREATMENT

DR THOMAS H. RUSSELL read a paper with the above title, for which see page 238.

DR HOWARD LILIENTHAL said that he was more convinced than ever that the abdominal route is not to be preferred to the supraphrenic, but he tries to avoid entering the pleura. Doctor Russell had shown very clearly that thoracic complications are not uncommon in subphrenic abscess. Therefore, Doctor Lilienthal believes that by making an exploration above the diaphragm certain of these complications could be discovered in their incipency. For example, empyema may have resulted from the perforation of a small subphrenic abscess. By the supraphrenic route such sacculated empyemas can be drained without infecting the general pleural cavity. The speaker operated, using local anaesthetic, by the following method.

The patient lies prone with a pillow underneath his abdomen and with his head lower than the location of the proposed incision. This posture was first recommended by Dr Charles A. Elsberg. A portion of the ninth rib is subperiosteally resected, the pleura pushed away from the diaphragm and the subphrenic abscess then aspirated and drained. Supraphrenic collections of pus in the neighborhood of the subphrenic abscess will be found and can also be drained. If during the approach the pleura should be accidentally opened, very little air will enter because of the posture of the patient. It is then pos-

SUBPHRENIC ABSCESS WITH REFERENCE TO TREATMENT

sible to suture the upper edge of the pleura to the diaphragm at a distance from the wound of entrance so that a large area is exposed through which aspiration and then drainage can be accomplished. It has even been possible to use a rib spreader and thus thoroughly expose the phrenic dome. Exploratory puncture through the unopened skin is not advisable in these cases but with the exposure made as outlined above the needle may be used and one gets an idea from the density of the tissues traversed that the abscess is near. The mortality in cases treated by this method must be very low. If there is pain in reaching a low sacculated empyema it may be necessary to supplement the local anæsthetic with general anæsthesia. Once having entered a supraphrenic empyema it should be widely opened and the region toward the mediastinal side should be explored for these cases often form mesial empyemas connected with the supraphrenic.

To illustrate one advantage of the high approach Doctor Lilienthal briefly outlined the case of a young man who in the course of paratyphoid fever developed a subphrenic abscess which perforated the diaphragm and, going still further, involved the lung itself in the suppurative process. By the method here described it was possible to drain the lung abscess as well as the subphrenic.

From long experience in abdominal, as well as in thoracic surgery, Doctor Lilienthal expressed his conviction that, other things being equal, the shock following an operation for thoracic suppuration is less than that which is seen in similar abdominal infections. Drainage from below secured by dissecting up over the dome of the liver is by no means always satisfactory and counter drainage posteriorly must often be made.

DR SEWARD ERDMAN said that as Doctor Russell had so definitely condemned the commonly used method of draining subphrenic abscesses by approach laterally, between or through the ribs, and recommended an anterior, transperitoneal, drainage, it seemed unfortunate that Doctor Russell did not give the mortality in his series of cases.

In order to carry conviction that the abdominal approach was superior, a very convincing lowering of the mortality rate must be shown.

He thought Doctor Russell had included several cases of abscess following operations on the biliary tract where the local collection of pus or retained bile would naturally call for approach through the operative incision, and it would seem that there could be little difference of opinion about this.

But for true subphrenic collections well up on the superior surface of the liver, Doctor Erdman still believes that the lateral approach through the ribs afforded the most direct and satisfactory drainage and he felt that the exploratory needle used at the time of operation was most helpful in locating the pus.

On the Second Surgical Division of the New York Hospital a consecutive series of twenty-one operations for subphrenic abscess showed seven deaths (33 per cent.)

Sixteen of the cases were complications of other serious conditions

NEW YORK SURGICAL SOCIETY

- 11 cases of appendicitis with peritonitis (5 deaths)
- 2 perforated duodenal ulcers (2 deaths)
- 1 acute cholecystitis
- 1 suppurative pleurisy
- 1 splenic anaemia

It is seen that all the deaths occurred in cases where peritonitis was the underlying cause of the subphrenic abscess, and largely responsible for the deaths

The remaining five cases were primarily diagnosed as subphrenic abscess, these were all drained through the ribs and all of them recovered, the needle was used in each of these cases

DR ROBERT T MORRIS said that in the group of cases suitable for abdominal approach there is one instrument especially useful and that is a big urethral sound. It is curved just right to curve up over the dome of the liver. When pus escapes a large, hard tube can be inserted, following this with the use of Dakin's solution. These cases will do very well under that sort of treatment.

DR JOHN DOUGLAS said as to the question of diagnosis in these cases Doctor Russell spoke of the gas which usually forms under the diaphragm. Gas usually does form in these cases when the infection is due to anaerobic bacteria. The bubble of gas which collects under the diaphragm with the patient in the erect position, or at the highest point with the patient lying on the side, is one of the greatest helps that he knows of in helping make the diagnosis. As far as the incision is concerned he doubted as to the particular advantage of an anterior incision. He remembered having a case where a subphrenic abscess formed after an appendix operation and he made an anterior incision and had great difficulty in keeping the tube in place for drainage. By a posterior incision and approach he believes, as Doctor Lilienthal has said, it can be done with very little or no more than a moderate amount of difficulty under local anaesthesia. He believed that if one does accidentally open the pleural cavity it is almost always possible to wall that off at the time and wait twenty-four hours before going into the abscess cavity.

DOCTOR RUSSELL, in closing, said he thought, summed up, the point is, all agree these abscesses come from intra-abdominal diseases and it seems strange to him to go through the chest to help a condition following an abdominal infection. In answer to question about mortality rate Doctor Russell replied that he had not intended to convey the impression that these cases at the Post-Graduate Hospital were all opened through the front, some of them were opened through the side. A review of these cases had been made to arrive at the causes of the abscesses. He has been able to communicate with six cases he operated upon through the abdomen and they are well today.

BRIEF COMMUNICATION

WREDEN'S METHOD OF RECONSTRUCTING VOLUNTARY ANAL CONTROL

DEFICIENT control of the sphincter ani is one of the most crippling disabilities with which we have to contend. Numerous operative procedures have been devised to restore this function. In general they have been unsuccessful, except where the sphincter is merely cut or torn in one place, here suture of the cut ends is all that is necessary.

In the more complicated cases where the sphincter is either destroyed or its nerve control lost, the problem is far more difficult.

Wreden, of Leningrad, Russia, described in the *Archives of Surgery* for March, 1929 (vol xviii, No 3) a plastic method for the restoration of anal control, which was applied by me with success in the following case.

CASE—December 12, 1928, a man, forty years of age, reported at the office complaining of bleeding from the rectum. Two brothers had died of cancer—one of the stomach, one of the rectum. He has been bleeding for the past four months. Examination revealed, about five inches inside the anal sphincter, a hard, ulcerated mass which, under proctoscopic examination, was evidently a carcinoma. Wassermann negative.

December 17, 1928, under spinal anaesthesia, the rectum was dilated, and a small piece of tumor removed and subjected to microscopic examination. *Diagnosis*—Adenocarcinoma. An immediate perineal resection was done, the sphincter being dissected free and cut only on its posterior aspect. At the close of the operation the cut ends of the sphincter were united by suture.

The post-operative recovery was uneventful, but following the operation there was at no time any rectal control. February 20, 1929, a circular incision was made around the anal orifice and an endeavor made to suture the sphincter. This manoeuvre was completely unsuccessful and was followed by no improvement in control.

March 21, 1929, a plastic was done according to the method of Dr R. R. Wreden. 1 Under spinal anaesthesia two strips of fascia, each eighteen by two centimetres, were removed from the fascia lata and placed in normal salt solution. The patient was then put in the lithotomy position.

2 Two vertical incisions were made on the right and left of the anal orifice, half way between the anus and the tubera ischia, these incisions penetrated to the aponeurosis, covering the muscles of the perineum.

3 The fasciculi of the glutei maximi were then exposed by means of two crescent-shaped incisions, with their convexity directed laterally and posteriorly.

4 The upper and lower ends of the two vertical incisions were then connected by undermining the skin between them. Two forceps were then introduced transversely through each of the vertical incisions of the perineum anteriorly and posteriorly to the anal orifice, the forceps both directed to the left.

5 The ends of one fascial strip, caught by means of two forceps, were drawn through the left vertical incision. The other fascial strip was drawn by means of two forceps in the opposite direction. As a result the lower end of the rectum was encircled by two fascial loops.

BRIEF COMMUNICATION

6 Two forceps were then introduced through each of the crescent-shaped incisions and the skin between the crescent-shaped and the vertical incisions undermined. The ends of the fascial strips were drawn through the crescent-shaped incision and securely fastened to the fasciculi of the gluteus maximus muscle of the opposite side, one strip above and one strip below the fasciculi, where they were fastened by chromic-gut sutures. The same manœuvre was repeated on the other side. The anal orifice was thus enclosed by a fascial ring. The strips were sutured at tension sufficient to barely permit the introduction of the index finger. The wounds were closed with silk suture.

Defecation was delayed for ten days after operation, by the administration of opium. The wounds healed without suppuration.

Following the first movement of the bowels, the patient was told not to exercise any attempt at control. An examination of the sphincter at this time revealed normal dimpling of the anus and a distinct fascial ring just inside the orifice. Three weeks after operation the patient was told to try to exercise control of the sphincter by movement of the gluteus muscles. Control improved as the muscles were educated to their new function.

At the present time, five weeks after operation, there is rarely soiling at night, and only occasionally during the day when the bowels are loose is there a slight soiling of the pad. The patient knows when the rectum is full and is usually able to reach a toilet in time to prevent soiling. As time goes on control will undoubtedly grow more perfect.

Two cases of this kind, with a slight modification of the Wreden technic, and the use of prepared fascia (Koontz'), in place of fascia lata, were reported by H. B. Stone, of Baltimore, one unsuccessful and the other successful. So far as I know this is the fourth case of this kind done.

J. LOUIS RANSOHOFF, M.D.
of Cincinnati, Ohio

BOOK REVIEW

DISEASES AND DEFORMITIES OF SPINE AND THORAX By ARTHUR STEINDLER, M D 8vo , cloth , pp 573 St Louis, C V Mosby Company, 1929

Doctor Steindler, in his previous work on "Orthopedic Operations," and in other writings has always shown such painstaking detail in description and such smoothness in diction that one is led to expect his latest contribution to orthopedic literature to be both instructive and interesting. The general surgeon and medical practitioner also would do well to acquaint themselves with the many useful points which have considerable bearing on pathological conditions and derangements not orthopedic. Then, too, the book is replete with suggestions on diagnosis and treatment of all forms of injury and fractures of the spine.

In the first chapter on Congenital Deformities he carefully takes up the life history of the centres of ossification of the component parts of the vertebræ, and shows how this must be understood in order to study the pathogenesis of congenital deformities.

Abnormal behavior in these centres is the cause of many of the anomalies. They are classified under three heads: (a) Morphological variations, (b) numerical variations, and (c) errors in regional differentiation. Under the first heading belong half vertebræ, wedging and fusing of vertebræ. The second includes increase or diminution of the number of vertebræ in each segment, and the approach in characteristics of a vertebra to those belonging to the adjoining segment—the most frequent example being the sacralization of the fifth lumbar vertebra. In the third class are the anomalies due to suppression of parts of the vertebra. This is most frequently seen in the posterior segment. Here the author discusses spina bifida occulta, stating concisely the pathology, peripheral symptoms, X-ray findings and treatment. The X-ray has shown a more frequent incidence of a spinal cleft, and it has been found that peripheral deformations such as club foot and claw foot may result. The differentiations between the symptomless cleft and the one producing anomalies are well brought out. Spondylolisthesis is included properly in this classification because due to incomplete ossification of the neutral arch except, occasionally, where following a fracture. This chapter is profusely illustrated with photographs and X-rays, and the latter show what is intended, which is not always the fact in medical literature. The same good photography is in evidence through the succeeding chapters. The cervical rib is given the considerable space it deserves in differential diagnosis and indication for operative procedure. Rare deformities and malformations of the thorax, congenital, follow, and the chapter is closed with a comment and a very complete list of references, and the same with each of the ten chapters.

BOOK REVIEW

Chapter two deals with static anteroposterior deformities of the spine—a very readable presentation of the subjects of posture and visceroptosis, and the static constitutional deformities of rachitis and osteochondritis. The literature of posture is abundant, but the author's picture by word and photograph of the varied types, tall and slender, short and heavy, and normal anatomic types and their behavior in faulty posture, and the relations between posture and visceroptosis, is very clear. Then he takes up the treatment by exercise and mechanical support. There is a short discussion of osteochondritis and vertebral epiphysitis.

The third chapter, with seventy pages of reading matter and over twenty of illustrations, deals minutely with the anatomy, mechanics, and dynamics of the normal, and scoliotic spine—followed by the pathogenesis and classification. In the diagnosis and treatment, stress is laid on the prescoliotic stage, in which the "postural and attitudinal anomalies first begin to appear," and where the most effective work can be accomplished. All methods of treatment from those of the ancients up to those of the present day, by gymnastics, apparatus supportive and corrective appliances, surgical, and his own technic of treatment by compensation, are stated in clear detail. Fractures and dislocations of spine and thorax in the fourth chapter are concisely classified, but dealt with more briefly than the larger subject of scoliosis.

The fifth chapter is devoted entirely to low back pain—one of the most frequent, as well as most difficult, disabilities coming to the physician. The subject is treated anatomically, mechanically and pathologically as clearly as the intricacies of the condition permit. Fully half the chapter on tuberculosis of the spine is given up to treatment by recumbency and heliotherapy, plaster jacket, and operative fusion. Opinions of many writers, American and foreign besides the author's on the relative value of conservative and operative methods, will show the reader the diversity of practice among specialists and provide much food for thought. The operations are well described and illustrated.

The different forms of osteomyelitis and syphilis of the spine occupy much less space, as of less frequent occurrence. Chronic arthritis and tumors, followed by the appendix, providing a synopsis, complete this most interesting and instructive work.

CHARLES DWIGHT NAPIER

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FRACTURE DISLOCATION OF THE CERVICAL SPINE*

BY ALFRED S TAYLOR, M D
OF NEW YORK, N Y

FOR many years these lesions of the cervical spine resulted chiefly from diving accidents, football injuries, falls from horses, and weights falling on heads. Nowadays automobile wrecks add many cases to the list. Most of these injured people are cared for by general surgeons.

Since methods of procedure vary greatly, and since ill-advised immediate

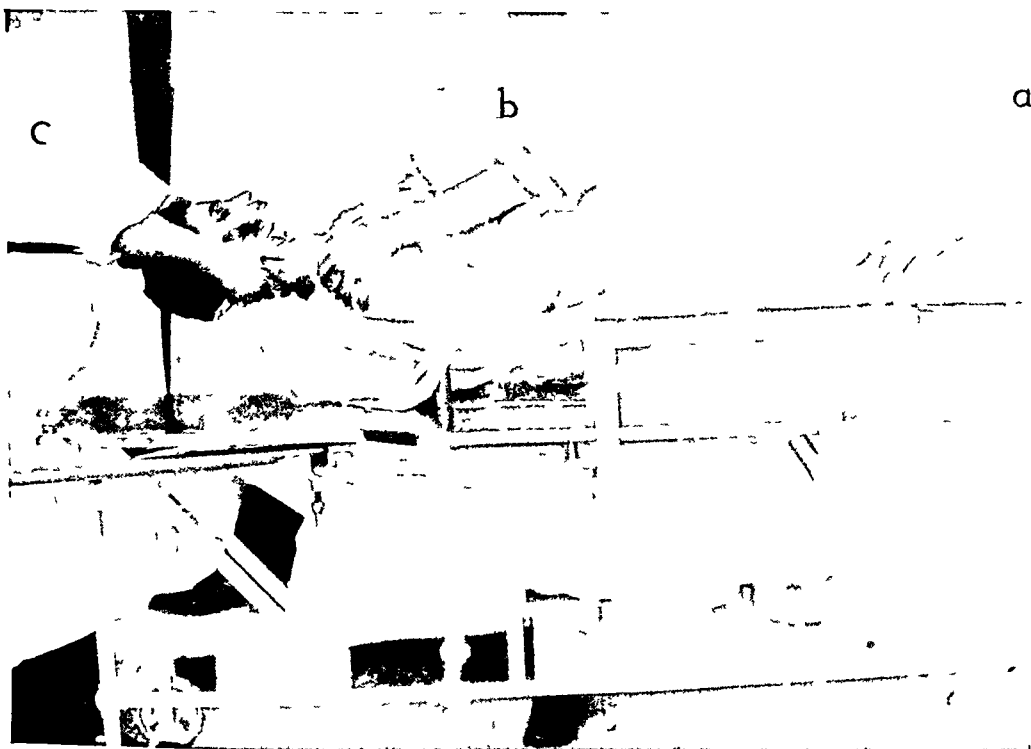


FIG 1.—Patient on Hawley fracture table with everything ready for reduction (a) Counter extension on lower extremities, (b) steadying of shoulders to keep patient from slipping off the narrow metal spinal strip, (c) operator exerting traction by his body weight while steadying the head and neck with both hands

operation is urged in many instances, an attempt should be made to establish certain fundamental principles as guides to treatment.

These principles can be deduced only by orderly consideration of the pathological features, which in turn result from the etiological factors and then to determine the aims of treatment and the best methods of attaining the desired results.

It is evident that the bone lesion, *per se*, is of relatively minor importance, and that the seriousness of the injury depends entirely upon the damage, present and prospective, of the nerve tissues involved. The sole aim of treatment must be to repair or prevent damage to the nerve structures—a result greatly furthered by reduction of bony deformity. It is fundamental to clearly under-

* Read before the New York Surgical Society, April 10, 1929.

stand the pathology involved in order to work out the principles of treatment

For the sake of clarity we must differentiate the cases due to (1) Direct violence, and (2) indirect violence (usually hyperflexion)

Those due to direct violence scarcely enter our present discussion, because direct violence sufficient to cause dislocation of vertebral bodies would do irreparable damage to the cord, and almost surely cause immediate death

Indirect violence, acting through the mechanism of hyperflexion, in the cases under discussion, is the cause of the pathology, which always involves



FIG 2—Details of head end of apparatus. Suspension head strap with gauze pad in the chin part to soften the pressure. A similar arrangement made of two ply moleskin, or heavy Z O adhesive is easier on the patient and can be incorporated in the plaster case with less discomfort to the patient.

(1) The spine and its accessories, (2) the cord and meninges to variable degree, (3) nerve roots to variable degree

In each of these structural groups the resulting pathology may be classified as immediate and remote

I SPINE *Immediate*—The most important element in the spinal injury is the dislocation, as this to a large degree determines the amount of injury to the spinal cord

Associated with this dislocation there is

(a) Nearly always comminuted fracture of the tips of the articular processes involved

(b) Always rupture of articular ligaments

(c) Always rupture of the intervertebral disc, frequently with damage to one or both of the vertebral bodies to which it was attached. The blood supply to both the disc and the vertebral bodies is seriously impaired

(d) Frequently comminuted fracture of the anterior edges of the vertebral bodies

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(e) In a few very severe injuries, gross fracture of one or both of the vertebral bodies concerned, as well as occasional fractures of the posterior arches

Remote—Persisting deformity, if not reduced at or shortly after the time of injury. Even when satisfactory reduction is accomplished, there are sure to be certain secondary changes which have an important bearing on the methods and duration of the treatment.

The intervertebral disc, which has been contused and ruptured and has



FIG. 3—During reduction. Note the rope about the operator's waist running through the rings of the headpiece. The operator by leaning back uses his weight as a steady traction machine under perfect control. The operator's hands support the neck and occiput, with the index fingers just below the lower of the two vertebræ involved. The thumbs lie in front of the neck and can be used to push the upper of the two vertebræ upward and backward while the index fingers crowd the lower vertebræ forward, as soon as the muscles have yielded sufficiently to the steady traction. An assistant steadies the patient on the metal strip, also pulls downward on the shoulders.

had its blood supply damaged, undergoes gradual degeneration and absorption, especially in its anterior portion, so that eventually the vertebral bodies come in contact anteriorly and undergo bony union.

In cases not properly cared for the vertebral bodies may undergo considerable erosion before bony union occurs because they have been injured, their blood supply damaged, and the intervertebral disc buffer largely absorbed. The amount of erosion can be largely influenced by treatment. In any case, the absorption of the disc anteriorly causes some angulation of the spine and this angulation will be increased by erosion of the vertebral bodies, which is always most marked in front.

Eventually bony union occurs between the vertebral bodies in front, and between the articular processes behind, and whatever deformity is then present becomes fixed. Marked angulation, fixed by bony union, is a constant menace to the cord from the continuous pressure of the cord against the angle.

2 *CORD Immediate*—The cord may be merely contused, may be completely severed or may suffer any degree of injury between these two extremes. There may be hæmorrhage—usually punctate (or gross, rarely). Within a few hours post-traumatic œdema occurs, varying with the degree of injury. The dura rarely shows gross damage except when punctured by a bony fragment and this happens infrequently.

The pia-arachnoid is damaged in the more severe cases, with resulting hæmorrhage and subsequent adhesions to cord and dura.

The cord fibres which are ruptured by the primary injury undergo permanent degeneration, the other fibres may suffer temporary or permanent loss of function because of swelling due to hæmorrhage or œdema within the cord causing pressure against an unyielding dura, or because of continuing external pressure from extradural clot or displaced bone. Continued pressure, when sufficiently severe, results in permanent degenerative changes in the cord structures.

FIG 4—(Case II) Before reduction. Dislocation of the fifth cervical forward on the sixth cervical vertebra. Note locking of articular processes and that extension at first must be forward to unlock them with the minimum force and traction.

Remote—Aside from the persisting results of damage to the cord by the primary injury and the secondary hæmorrhage and œdema, there is one other important source of remote pathology.

When the cord has escaped entirely, or almost entirely, and has recovered, but the bone deformity has not been corrected and prevented from recurring by proper treatment, after a period varying from a few months to a year, there is likely to develop a transverse pressure myelitis of the segment of cord which rides over the backward-projecting upper margin of the body of the lower vertebra and beneath the posterior arch of the vertebra above, with corresponding loss of cord function.

3 *NERVE ROOTS Immediate*—The two nerve roots emerging between the two vertebræ involved are nearly always injured. As the majority of dislocations involve the



FIG 5—(Case II) Reduction first time. Note that intervertebral disc is diminished in thickness and articular processes are not quite seated home.

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fifth and sixth cervical vertebræ, it is usually the sixth nerves which are damaged, usually more on one side than the other

Remote—If bone displacement is not corrected, chronic traumatic neuritis with permanent impairment of function occurs. This impairment is usually incomplete

Symptomatology—The damage of the bony spine will be indicated by deformity (difficult to make out without undue manipulation), localized tenderness and pain, limitation of motion in certain directions, and characteristic forward attitude of head and upper neck

Stereoscopic X-ray plates give the most reliable evidence with the least traumatism. Lateral plates, stereoscopic, are the valuable ones

Damage to the cord is indicated by more or less complete loss of its function at and below the level of the injury. The degree of damage to the cord is very variable and is not necessarily in proportion to the bony displacement as found in the pictures. With some quite marked displacements there is relatively little evidence of cord injury, and in some profound injuries of the cord the bony distortion is not so much as one would expect. Marked bony displacement may occur with no evidence of primary injury of the cord

The first group with marked distortion and absent or only slight or moderate cord injury can be accounted for by the fact that the cord takes up but a relatively small proportion of the area of the cervical canal, and so may luckily escape

The second group, with moderate distortion and severe damage to the cord, are not so easily accounted for, but there are two mechanisms which may be postulated. One is that the distortion at the moment of injury is sufficiently great to injure the cord, and then is spontaneously partially reduced. This is a purely hypothetical explanation which is reasonable, but which cannot be proved or disproved

The other is that the cord is pulled forward and tensed by the hyperflexion of the spine and is bumped against the angulation of the bone at the level of injury

This seems a more valid explanation because of the following facts

- 1 The cord is anchored at its upper end by the structures at and above



FIG 6—(Case II) One year after the primary reduction, two recurrences of deformity having occurred and attempt at fixation by open operation having been made. Note the deformity, and that there is no sharp angulation of the spinal cord, that the intervertebral disc has almost disappeared anteriorly, and that bony union has occurred between the vertebral bodies anteriorly



FIG 7—(Case II) Four years after reduction showing ossification between bodies and articular processes of the fifth and sixth vertebrae. Note the extension downward of the anterior lip of the fifth cervical. Inter vertebral disc almost gone.

cords would be the ones to suffer most.

Not infrequently a case occurs in which there is marked impairment of function in the upper extremities due entirely to damage of the nerve roots, with evidence of cord injury entirely absent or very slight. This emphasizes the necessity of keeping clearly in mind the two types of nerve tissue damage in order to arrive at the correct diagnosis. A capable neurologist should always be called in consultation.

Damage to the cord is indicated by impairment of function below the level of the injury. This impairment may range from very slight to complete loss. Except in cases of complete loss there is usually unequal involvement of the two sides as to both sensory and motor function, this depending on the distribution of the dam-

the foramen magnum, and by the upper cervical nerves which pass out of the canal almost at right angles to the cord. The lower end is anchored by the filum terminale.

2 During laminectomies it is noticeable that some cords are less movable than others, *ie*, strung more tightly between the ends.

3 As the spine is flexed the distance between the two attachments of the ends is increased, and the cord naturally goes forward in the canal to seek the shortest distance between its two ends. For this same reason the spine is well flexed to get the caudal nerves forward out of the way in doing lumbar puncture for the various purposes of diagnosis and treatment.

4 Certain cases have been reported in which serious loss of cord function has followed injury associated with marked flexion of the spine, but without any discoverable lesion of the bony spine.

It is obvious that the relatively tense



FIG 8—(Case III) Before reduction. Note extreme forward displacement and tilting of the fifth cervical vertebra and locking of articular processes.

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age which the trauma has caused in the various conducting paths of the cord

Damage of the nerve roots is usually confined to the two which emerge between the two vertebrae involved. They are compressed and lacerated between the displaced bones. Pain and paralysis in the *root distribution* appear and the reflexes of the muscles supplied from these roots are diminished or absent, according to the degree of injury. If the bony compression is not relieved, a partial loss of function in these nerves may become complete. These nerve root injuries do not cause definite sensory disturbances because no one of these nerves supplies exclusive sensation to any area of skin.

One most important fact must be stressed, *ie*, when there is, primarily, complete loss of cord function below the level of the lesion, it is impossible to determine at once whether there is merely a complete physiological transverse block, or a true anatomical transverse lesion. In many cases there is a partial anatomical lesion, with complete physiological block of the remainder of the cord.

TREATMENT—As before stated the chief aim of treatment is the restoration and protection of nerve function. The first principle of treatment in a fresh case is to avoid causing additional damage. The history of the accident, the pain in the neck, and the visible evidences of disturbed function of the cord and nerves should suggest the diagnosis. Turning the patient, manipulating the neck, head, etc., to get corroborative evidence is not only painful but adds to the patient's risk. Evidences of sensory and pyramidal tract disturbances may be obtained without danger. Good X-ray plates give perfectly satisfactory evidence as to the bone distortion and can be taken with practically no manipulation of the patient, with modern portable apparatus. Immediately after the accident



FIG 9—(Case III) Taken on the table immediately after reduction, showing complete reduction



FIG 10—(Case III) Three days after reduction. In plaster case



FIG 11—(Case III) Six weeks after reduction Still in ease and alignment perfect

the patient should be placed on a flat stretcher, being careful to move the shoulders neck and head in one piece as nearly as possible Pillows or cushions under the head are undesirable because of their tendency to increase the dislocation For the same reason a sagging or hammock stretcher is bad because of its tendency to flex the spine and exaggerate the deformity

He is transferred to a flat bed The portable X-ray machine is used, lateral plates being much more significant than the anteroposterior ones which usually give no adequate idea of the distortion

With the diagnosis verified the second principle of treatment is to restore the various anatomical structures to their normal relations as nearly as possible This restoration minimizes the immediate, and prevents the remote injury to the nerve

tissues, by removing the continuous pressure of the displaced bones from the cord and nerves

The third principle consists in fixation of the spine from the lumbar region up to the skull, so applied as to cause some elongation and backward extension of the cervical spine above the level of injury This fixation must continue until bony union occurs as previously described, and this usually requires twelve months

The application of these principles, by a method to be described, will result in practically perfect restoration of anatomical relations and the best possible conditions for such spontaneous recovery as is possible in the damaged nerve tissues The sooner after injury the restoration is attempted, the more easily and perfectly will it be accomplished The only element of danger still to be faced is that of the œdema of the cord which follows these injuries, and may develop to such a degree as to menace that portion of the cord not irreparably damaged primarily This factor will be discussed later For the present, suffice it to say that the anatomical



FIG 12—(Case III) Sixteen months after reduction with the use of constant extension apparatus Note the absorption of the anterior portion of intervertebral disc with tilting forward of upper spine and consequent slight angulation Note also the well advanced ossification between the two vertebrae

FRACTURE DISLOCATION OF THE CERVICAL SPINE

restoration allows the maximum amount of space within the dura and so minimizes the menace of the oedema

METHOD *Anæsthesia*—As a rule the procedure is not painful and no general anæsthetic need be used. Where the cord has been so damaged that the diaphragm alone carries on respiration, general anæsthesia adds to the risk, as does morphine, by depressing the respiratory centre. Nevertheless in the third case, because of painful clonic spasms in the cervical muscles and a high degree of nervousness, general anæsthesia was used without undesirable consequences.

Before any manipulation starts, everything must be organized for smooth progression. A proper fracture table (*e.g.*, Hawley's) must be available, a good orthopædic associate with knitted shirting, padding, bandages and plaster for the jacket must be present, and a good, portable X-ray machine and technician must be ready to take and develop plates to verify the reduction when it is thought to have been accomplished.

Unless these details are carefully arranged beforehand the chances of complete success are diminished.

The method herewith presented was first tried in August, 1911. It is simple and has proved efficient.

The principle consists in controlled traction exerted on the head (with counter traction on the lower extremities) until the spasmodically contracted cervical muscles have relaxed sufficiently to permit reduction by bimanual manipulation on the part of the operator. Fixation is maintained by a plaster jacket involving the trunk and neck, the neck portion maintaining extension of the neck by pressure upward against the occiput and inferior maxilla and downward against the shoulders. The most convenient arrangement is that shown in the accompanying illustrations (Figs 1, 2 and 3). The patient is placed supine on a Hawley fracture table, with the trunk from the waist line upward supported on a narrow metal strip padded slightly and ending between the scapulæ.

An orthopædic suspension headpiece is applied. Through its two suspension rings which lie just above the vertex of the patient's skull a double light of clothesline is passed and is tied around the pelvic girdle of the operator, so as to keep the patient's vertex only a short distance from the operator who faces the patient and grasps his neck in the damaged area supporting the head also with his hands. Meanwhile, the lower extremities of the patient are bound to the table or held by strong assistants, to give counter traction.

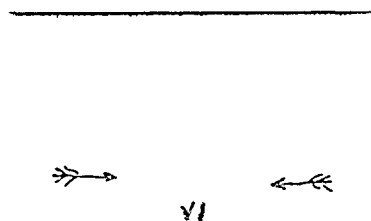


FIG 13—(Case III) Anteroposterior view at sixteen months, showing apparent fusion of the articular processes

Another assistant may be necessary to keep the patient's body balanced on the narrow metal strip between his scapulæ

When everything is ready, the operator applies traction on the neck muscles, gradually and increasingly, by backing his body away while holding the neck between his two hands, thus maintaining absolute control of the whole procedure. The traction is at first exerted in the axis of that portion of cervical spine *above* the injury so as to unlock the articular processes of the damaged vertebrae. After traction for a period varying with the strength and degree of spasm of the neck muscles (from five to ten minutes) the neck will be felt to elongate gradually, the bones to unlock, and then the



FIG 14 —(Case V) Left side picture shows dislocation of fourth cervical on fifth cervical vertebra. Note the wedge shaped compression of fifth cervical the comminuted fragments projecting forward, and the displacement of the body backward into the canal. Mid picture—The alignment after reduction by vertical suspension (in association with Dr J J Moorehead). Right side picture—In plaster case two days after reduction.

head and upper spine are allowed to sag gently downward while still under traction until reduction is accomplished, the operator's hands assisting by propping the lower segment of the cervical spine posteriorly and manipulating the upper segment gently with the thumbs anteriorly, if necessary, to complete the reduction.

Reduction is indicated (a) Sometimes by the patient who feels the bones slide into place, with immediate relief of previous discomforts, (b) by finding the spinous processes in proper alignment and spacing, (c) by a plate taken by a portable machine and developed while the patient is retained on the table. This last is always done as a check.

As soon as the reduction is verified, a good orthopædist should apply a well-padded plaster-of-Paris jacket (previously described) while the operator maintains the head and neck in correct position. This jacket should insure moderate extension of the neck between the shoulders and occiput and chin, with slight backward flexion of the head and upper part of the neck to check any tendency to recurrence, or to undue erosion of the anterior portions of the damaged vertebral bodies.

FRACTURE DISLOCATION OF THE CERVICAL SPINE

It is very important to have the jacket include the trunk down to the iliac crests in order to have firm fixation for the cervical portion

In Case II the plaster jacket was replaced by a reinforced leather collar and breast plate, and in Case IV a plaster collar with a broad extension down over the chest and back was used, but these failed to prevent recurrence

After-treatment consists in keeping the jacket on for several weeks (three to four), taking an occasional film to make sure that reduction is maintained. At the end of this period the jacket may be split down each side and carefully removed to permit measurement for a spinal brace with jury-mast and cupped arrangement to fit and hold up the chin, jaw and occiput. The cast is then replaced, fastened with adhesive plaster, and left on until the brace is ready. When this is applied the patient may get up when able.

From the time of reduction such physical therapy as is indicated and feasible should be systematically used during the entire period of convalescence.

In Case V, because no suitable table was available, Doctor Moorehead suggested that we use the regular orthopaedic suspension apparatus. The patient on a stretcher was placed under the suspension frame, the headpiece was applied, and he was carefully lifted to the sitting posture as the head was pulled up by the fall and tackle which was vertically above him. Traction was gradually increased the body being held in the vertical sitting position and acting as the counterweight. After a few minutes the muscles relaxed and by gentle manipulation reduction was accomplished (Fig 14). The jacket was applied as soon as the film verified the reduction the suspension strap about the chin and occiput being left *in situ* (and extracted three days later).

The procedure worked out perfectly in



FIG 15—(Case VII) Two months after accident. Fifth cervical on sixth cervical vertebra. Note the angulation, also the chipping of the anterior upper margin of sixth cervical, and the apparent projection backward into the canal of calcified material from the contiguous margins of the two vertebrae.



FIG 16—(Case VII) Taken on the table just after reduction which was obviously complete. Note the thinning of the disc and the roughened outlines of the approximated vertebral surfaces.

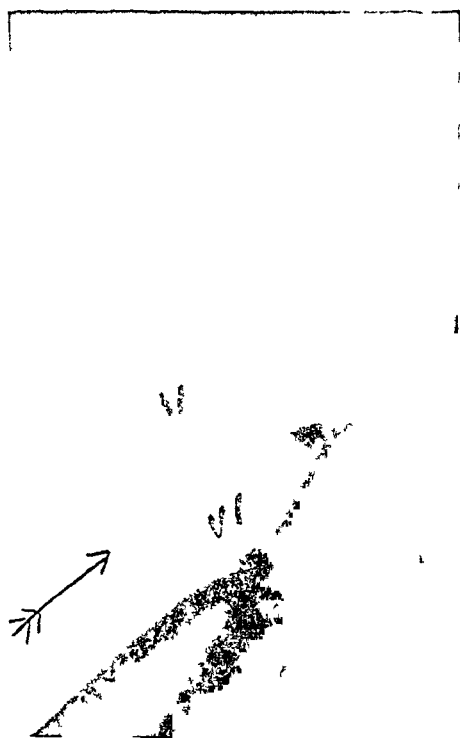


FIG. 17—(Case VII) Three weeks after reduction while in a steel brace. Ossification is apparently present between the anterior margins of the two vertebrae. Apparently his osteoarthritic tendency greatly hastened his function.

the cord has shown but little evidence of damage, then fixation by brace should be used until ossification has occurred. If, during this time, evidences of increasing cord involvement appear, usually indicated by advancing spastic paresis, decompression by laminectomy is indicated. (An interesting and ingenious ambulatory extension apparatus devised by Dr J. E. J. King is referred to in Case VI.)

Open operation in the acute stage of these injuries must be mentioned, chiefly to draw attention to its very great dangers.

- 1 The handling necessary to posturing the patient on the table for operation, and returning him to his bed, involves great risk of added damage to the cord, especially as the attendants are not likely to have had much experience in handling such cases.

- 2 The removal of the arches takes

this case and the position greatly facilitated the application of the plaster jacket. He was a young lad, not so very heavy, and although completely paralyzed below the sixth cervical segment, could be handled with reasonable ease.

With a full grown adult the procedure would involve rather greater risk of accident in the handling and does not permit quite the same facility in manipulation of the head and upper spine during reduction.

In cases where the elapsed time has been such (see Case IV) that reduction by these procedures cannot be accomplished because of the fixation of the tissues about the area of injured spine, suspension traction over a period of weeks should be tried, just as in the case of overriding fractures in long bones. The same suspension headpiece is applied and tied to the head of the bed which is then elevated so as to use the sliding body for traction. If this does not succeed, and



FIG. 18—(Case VIII) Second cervical on third cervical vertebra on the right side. At first sight there seems little evidence of deformity. The second body projects more forward over the third than the others and careful inspection of the spinous processes of second cervical and third cervical vertebra in this plate and the next will show that second cervical is abnormally forward.

FRACTURE DISLOCATION OF THE CERVICAL SPINE

away a large part of the remaining stabilizing apparatus at the site of the injury

3 Open operation cannot so readily reduce the deformity, as can the method described and the only thing that it can accomplish is decompression of the damaged cord by a generous laminectomy with splitting of the dura from a point well above to a point well below the oedematous damaged portion of the cord

Many years ago three cases were operated upon in this manner by the author, the interval between injury and operation varying from one to four days. They were in good general condition except for the loss of cord function below the sixth cervical segment

In each case when the dura was split, the cord fractured and extruded damaged fragments

Shortly after operation the temperature rose steadily to 107° F and death occurred within twenty-four hours. The change was startling and discouraging

4 Operation involving the cervical cord carries much greater risk than operation on lower portions of the cord

The only reliable indication for operation in spinal cord injuries, as brought out by Coleman, of Richmond, is evidence of subarachnoid block as indicated by the manometric test, and even in the presence of such complete block in the *cervical* region, the above disastrous experience would make me hesitate

If after the vertebral bodies have become reasonably consolidated, there develop signs of transverse myelitis (and this is very likely to occur in cases which are merely put up in fixation apparatus without the reduction of the dislocation), a laminectomy, involving at least one above and one below those vertebrae originally damaged should be done and the dura be split and left open the entire length of the exposure. This allows backward displacement of the cord and release from pressure on its columns

ILLUSTRATIVE CASES

CASE I—W. B. L., male, seventeen years of age. Forward dislocation of fifth cervical on sixth cervical resulted from a diving accident on August 12, 1911, with complete loss of cord function below the sixth cervical segment. During the first week there was a slight return of sensation, slight movement in the great toes, but no recovery in the sphincters. Films showed fifth cervical displaced forward on sixth cervical about one centimetre. Reduction was done August 10, 1911, without anaesthesia. Recovery was increasingly rapid. Sphincteric control was complete within two months and within a year he was driving his car, dancing, etc. The only residual was a slight spasticity of the lower extremities and a slight hypaesthesia of the tip of the right index finger (injury



FIG. 19—(Case VIII) After reduction. Note the difference in relation of bodies and spinous processes compared to Fig. 18

of nerve root) When seen at the end of nine years there was much less but still slight spasticity The hypæsthesia of the index finger had disappeared

CASE II—J F, male, twenty-seven years of age Previous history recurrent dislocations of the left shoulder and both patellæ following injuries Forward dislocation of fifth cervical on sixth cervical while wrestling on February 23, 1920 (Fig 4) Marked pain on movement of head and neck Marked, though incomplete, motor and sensory loss in both upper extremities with pain in the neck and shoulders (brachial plexus roots injury) Very slight sensory-motor disturbance in the trunk and lower extremities, with increased knee-jerks and ankle-jerks Babinski absent, and Oppenheim present on both sides (*ie*, very slight cord injury) No loss of sphincters Reduction without anæsthesia March 3, 1920 He felt the bones slip into place in about five minutes, said his pains had stopped, and the arms moved more freely (Fig 5)

The plaster jacket was applied After a week it became irksome, was removed and a lighter one substituted On March 17 a leather collar was substituted and he returned home

March 23 1920 (twenty days), films showed a recurrence He had removed the collar against instructions

March 26 a second reduction was accomplished and jacket applied A spinal brace with jury-mast and head support was substituted for the jacket

June 16, 1920—Complete recovery of motion, power and sensation except slight limitation of backward movement of right arm

June 19, 1920—Films showed partial recurrence

June 24, 1920—Under local anæsthesia the laminae of fifth cervical and sixth cervical vertebrae were exposed Manipulation caused very slight reduction and this could be retained only by heavy silk sutures encircling the spinous processes and laminae of the two vertebrae (Recurrent dislocation seemed to be his habit)

March 17, 1921 (one year after injury), there was bony union between the two vertebrae and the brace was discarded (Figs 6 and 7)

The recovery of sensation and motion was complete There was slight increase in the knee-jerks but no sign of spasticity in the gait

CASE III—L Z, female, thirty-five years of age October 25, 1922 Thrown from an automobile and landing on the back of the head she suffered complete loss of cord function from sixth cervical downward There were great pain and spasms in the neck muscles up to the time of reduction

October 26, 1922 (twelve hours after injury), all motion lost below sixth cervical segment, sphincters paralyzed, reflexes absent except slow plantar flexion of right great toe Sensation absent except for vague pain on deep pressure of the calf muscles and forcible extension of great toes The film showed extreme dislocation of fifth cervical on sixth cervical (Fig 8) Respiration was entirely diaphragmatic

October 27, 1922—Ether anæsthesia because of pain and muscle spasm in the neck, and the patient's insistence Reduction was readily accomplished (Fig 9) and the jacket applied The pains and spasms ceased at once On the sixth day the toes of the right foot, and the left great toe moved Within three weeks respiration was again becoming thoracic On the fiftieth day she recovered bladder control In three months she stood

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without assistance, but not very steadily, and returned home with a leather collar and jacket support. Improvement was slow but steady.

March 26, 1924 (seventeen months after injury) there was good bony union of the vertebræ and the brace was discarded (Figs 12 and 13). She could walk quite steadily alone. The left lower extremity was rather spastic with normal sensation, while the right lower extremity had perfect motion and power with almost complete loss of sensation (Primary intramedullary damage). The right upper extremity showed perfect recovery and the left had made marked recovery, but still showed spastic contraction in the fingers. She had returned to her position as an office executive six months after her accident.

CASE IV—H P, female, thirty-six years of age. October 1, 1925, she slipped on stairs and struck on the occiput. There was no evidence of damage to the cord or nerves, but from the time of accident there was limitation of movement of head and neck because of pain, embarrassed respiration from a sense of pressure and pain in the neck, dysphagia, and pains in both shoulders and the substernal region. There was no disturbance of the lower extremities. The upper extremities had free range and power of motion but abduction at the shoulders caused pain in the neck.

The spinous process of fifth cervical was prominent while that of fourth cervical was abnormally displaced both as to distance above that of fifth cervical and as to depth in the neck. Also fourth cervical was extremely sensitive to pressure. The films showed marked displacement forward of fourth cervical on fifth cervical with the usual forward tilting of the upper cervical spine. The head was rigidly held forward by the spasmodic neck muscles.

She was a tall, well-built woman, quite well except for the result of her injury. It was a month after the accident before she sought advice and had films taken. Because of the pains and spasm of the neck muscles and distortion of the spine, reduction was attempted. No anæsthetic was necessary. She was supine on the table. After ten minutes of traction, the muscles relaxed and stretched. As the manipulation seemed to cause the bones to slip into normal

relations she remarked that her respiratory pains and dysphagia had disappeared and the arm pains were much less. (No portable X-ray apparatus had been available.)

A plaster collar with a large breast plate was applied. A film taken after the collar was applied showed but little change in the deformity, yet something must have happened to have caused the above relief. Ten days after the reduction (?) pain recurred in the left arm, but there was no difficulty in breathing or swallowing. Two further attempts were made at reduction but were unsuccessful and she was finally sent to an orthopædic service. After prolonged treatment the vertebræ fused in bad position, but without the development of symptoms of cord or nerve damage.

CASE V—S H, male seventeen years of age (Courtesy of Dr J. I. Moorhead). November 20, 1925, he suffered fracture dislocation of fifth cervical on the football field with loss of consciousness and complete loss of cord function below fifth cervical. The film showed crushing of the body of fifth cervical with displacement backward about 5 centimetre and forward dislocation of fourth cervical on fifth cervical (Fig. 14). Reduction was accomplished within six hours of the accident.



FIG. 21.—(Case IX.) Courtesy of Doctor Stookey. Before reduction. Note the body of sixth cervical directly in front of seventh cervical vertebra. Note the spinous process and part of the lamina of sixth cervical remaining in normal position. The cord must have been severed. Relief of the localized pain was sufficient indication for reduction.

Because a proper fracture table was not available the boy was held in sitting posture on a stretcher, the headpiece was attached to an overhead pulley and his body was allowed to be the counterweight. No anæsthetic was used. After a short period of traction, reduction was accomplished (Fig 14) and the plaster jacket applied. There was no recovery of cord function.

On the third day an automatic bladder was established. On the fifth day pneumonia developed and he died on the sixth day.

CASE VI—R. S., female, fifty years of age (Courtesy of Dr J. E. J. King). On January 22, 1927, she fell downstairs landing on her back and head. There was pain and stiffness in the head, neck and back for two or three days. There was also paresis of and some hypæsthesia over the left deltoid. After three days all symptoms disappeared except the deltoid disability and hypæsthesia, and slight pain in the neck. She was not conscious of any serious disturbance of the neck, sought no advice, and did her housework as usual.



FIG 22—(Case IX.) Taken on the table just after reduction. Pain was promptly relieved. Note the almost perfect reduction of sixth cervical vertebra and the close approximation to the fractured spinous process.

After six weeks she sought advice because of persistent pain. Films showed marked forward dislocation of fourth cervical on fifth cervical with posterior edge of fourth cervical near the anterior edge of fifth cervical which was comminuted (Fig 23). There was also some crushing of the left side of the body of fifth cervical. There was a depression where the fourth cervical spinous process should have been. The neck was short and thick. The left deltoid muscle was parietic and atrophied and there was a small area of hypæsthesia over it (nerve root damage). There was a suggestion of weakness in the external rotators of the left humerus and the supinators of the forearm. The only evidence of injury of the cord consisted of exaggeration of patellar, suprapatellar and Achilles' jerks and an exhaustible ankle-clonus on the right side.

Because the positions of the damaged vertebrae favored the development of transverse myelitis from pressure (already beginning) or completion of the dislocation with trans-section of the cord by some minor accident, reduction was advised, in spite of the six weeks which had elapsed. Doctor King made the suspension headpiece of moleskin plaster, which is softer and smoother than the leather headpiece, and rigged a fall and tackle which was fastened to the headpiece, while the patient was seated on a low stool directly beneath it. Increasing traction, the patient's seated body acting as counterweight, gradually stretched the muscles. After five minutes, finger manipulation was used to favor reduction and a film was taken. This showed progress but not satisfactory reduction. After five minutes more of traction and manipulation, a film showed fairly satisfactory reduction (Fig 24). The plaster jacket was applied. During the process no anæsthetic was used. She lost consciousness for a few seconds four times.

That night, because the patient complained of pain in the neck, the gentle-hearted house surgeon cut away the entire chin support of the plaster jacket. This, of course, allowed partial recurrence of the dislocation (Fig 25).

She refused another immediate reduction with the fall and tackle so Doctor King devised a very ingenious brace to cause constant traction upward on the head and neck. The body of the brace was fastened to the shoulders and chest as a foundation. Uprights on each side of the head were united by a cross-piece well above the head. The uprights

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were attached to the shoulder-pieces by joints such that the uprights could be fixed at any angle so as to determine the direction of traction. The headpiece of moleskin plaster was applied and fastened to the cross-piece above the head by rubber bands (or spiral steel springs)

By these means the traction was controlled both as to direction and force. In this case the apparatus did not cause reduction (Fig 26), and the vertebral bodies showed bony union in the distorted position nineteen months later. Laminectomy will be indicated if signs of pressure myelitis develop as a result of the deformity.

This apparatus may be admirable for ambulatory cases where immediate reduction is not possible. Whether it will answer as comfortably, in paralyzed cases confined to bed, as the old method of suspension which uses the body as counterweight, remains to be seen. Certainly, where the cord has been seriously damaged, the earliest possible reduction is desirable so that the first described method should be tried first.

CASE VII—J. H. B., male, fifty-nine years of age. He was always a rugged athletic man, playing tennis, golf (including the nineteenth hole), walking ten to fifteen miles at a stretch, etc. February 4, 1928, while walking in the evening he stepped off a four-foot embankment, bumping first the lumbar, then the thoracic re-



FIG 23—(Case VI) Before attempted reduction, six weeks after accident



FIG 24—(Case VI) Showing fairly good reduction

gion and finally the occiput. While not unconscious at any time, he was unable to call loudly enough to be heard for quite an interval. When found he could move neither arm nor the left lower extremity. There was a slight scalp wound and he had severe pain in

his back and neck. At a local hospital, examination including X-ray films, was reported to show no evidence of serious injury to the head or spine. (Evidently the plates of the cervical spine were anteroposterior only, which usually give little or no evidence in any of these injuries.)

After a week the paralyses began to improve and he was urged to walk and especially to swim (being far South) as that was considered a curative exercise for paretic limbs. Swimming was not a success and the attempt caused much pain. The right upper extremity improved considerably but the digits had but little power. The left upper extremity improved but little. The left lower extremity recovered fairly rapidly so that he walked with increasing facility.

About April 1 (two months after the accident) he returned to this country and his physician who suspected injury of the cervical spine had further films taken. These showed fifth cervical dislocated forward on sixth cervical one centimetre and tilted so that the upper cervical spine tilted forward about 20° (Fig 25). The anterior upper edge of sixth cervical had been chipped off and another smaller, suggested a chip from the lower posterior margin of fifth cervical in the center. The rest of

the spine showed marked osteo-arthritic changes especially in the lumbar vertebrae and sacro-iliac joints. The head was carried somewhat rigidly forward and movement caused pain and grating sounds. There was marked tenderness over the lower posterior cervical spine and the anterior neck muscles were rigidly held to prevent movement. There was marked pyorrhea.

He was a short, heavy, muscular man with a large abdomen, in good general condition. Movements of the shoulders and elbows were normal and had good power. The right wrist, thumb and first two fingers had fair movement and power. The ring and little fingers had only slight power of flexion. The reflexes were normal. The left wrist and hand were practically powerless.

The reflexes of the upper muscles of the left extremity were more active than the right. The left lower extremity was spastic, but movement was good. Babinski sign was present on the left. The deep reflexes of both lower extremities were exaggerated $L > R$. There was disturbance of thermal sensation in the right lower extremity. It was evident that there had been damage both to the cord and some roots of the plexuses.

Inasmuch as the bony distortion was sure to cause continuous undesirable pressure on both the cord and nerves, it was decided to attempt reduction, in spite of the long interval after the injury, and the generally unfavorable conditions.

April 4, 1928 (almost nine weeks after injury), he was given a preliminary dose of morphine, and reduction was attempted. At first the neck muscles resisted vigorously but finally relaxed and after ten minutes had elongated sufficiently to favor reduction. The neck was so thick that palpation gave no information. Therefore the head and upper neck were worked backward so that reposition ought to occur and films were taken. The third plate caught the

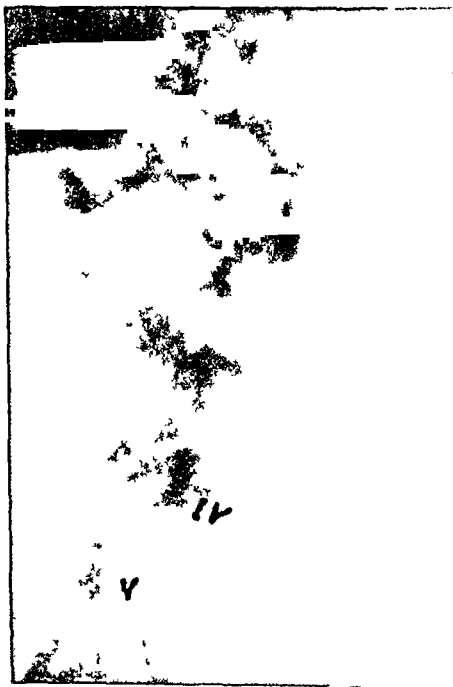


FIG 25—(Case VI) Recurrence three days after reduction

fifth and sixth vertebrae and showed practically perfect reduction (Fig 16). A plaster case was then applied.

He complained of the case bitterly, developed a "wet-brain" and then pneumonia so that the case had to be removed. When these complications had finished a brace was applied, but again caused bitter complaint. Meanwhile films showed the neck still to be in perfect condition, the right hand had made rapid improvement and the left hand had improved definitely (Fig 17). After about five weeks he discarded the brace against advice, and took the masseur with him into the country for the summer.

In the late fall of 1928 he reported that he was again playing tennis, and taking his walks. His left hand was not entirely recovered. When fatigued there were occasional twitchings in the leg muscles. As he has not returned to the city for personal examination no detailed status can be given.

CASE VIII—J A, female, four years of age. July 16, 1928, she fell down stairs cried from fright and then played as usual. Two days later the mother noticed that she held her head a little crooked, facing left, and that washing her face, brushing her teeth, etc., caused pain in the back of the neck.

July 19—X-ray films showed slight forward displacement of second cervical on third cervical (Fig 18). From the attitude of the head, and the slight displacement showing

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on the films, it seemed probable that the dislocation was unilateral and on the right side. There was no evidence of damage to the cord.

July 20, 1928, reduction was accomplished without an anæsthetic, and a plaster jacket applied (Fig 19). A month later the jacket was removed and a high, padded plaster collar was substituted. This permitted moderate lateral rotation of the head, but only the slightest flexion.

December 19, 1928 (five months after reduction), she seemed perfectly normal, there had been no pain or discomfort since the reduction, films showed perfect alignment, therefore the collar was discarded (Fig 20).

CASE IX—Male, twenty-five years of age. This case, in which I assisted with the reduction on his service at Beekman Street Hospital, is included with the kind permission of Dr. Byron Stookey.

The man, a steel worker, had slipped into the rubbish chute and fallen several stories landing on his buttocks. There was total loss of cord function below the seventh cervical segment. Breathing was entirely diaphragmatic. He was having severe pain in the neck. Films showed complete displacement forward of sixth cervical and displacement downward so that the body of sixth cervical seemed to be directly in front of that of seventh cervical, not tilted, but directly parallel with it. The spinous process and laminae stayed in place and just the body of the vertebra was dislocated forward and downward (Fig 21).

It was obvious that the cord must be hopelessly crushed or severed. Reduction was attempted to relieve the sharp pains which distressed him. After five minutes of traction by Doctor Stookey the neck muscles stretched and manipulation caused complete reduction which was shown by the film taken and immediately developed (Fig 22). The pain ceased. The patient lived for months, but showed no signs of recovery in the cord.



FIG. 26—(Case VI) Showing bony union between fourth cervical and fifth cervical vertebrae in distorted relation twenty one months after the accident (Nineteen after attempted reduction).

RESULTS—In all nine cases reduction was accomplished primarily (In Cases IV and VI incomplete). The interval between accident and reduction varied from two hours to nine weeks. An anæsthetic was used only in one case (III). In no case was any harm done by the procedure. It would seem not only simple, but safe. In Cases II, IV, and VI the dislocation recurred. In Case II because of the early substitution of a collar for the case. In Case IV because the plaster collar was used and evidently did not give proper support, and reduction was incomplete. In Case VI because of the removal of chin fixation a few hours after reduction. The deformity has become fixed.

Cases I, II, and VII—all with primary signs of injury to both the cord and nerves have made (I and II) complete recovery, and VII an almost complete recovery and still making progress.

Case VIII, with no signs of damage to cord or nerves, is freed from pain and limitation of head motion, and is perfectly normal.

Cases V and IX obviously had transection of the cord. Case V died in five days. Case IX lived for months with no signs of cord recovery.

Case III with very serious primary damage to both cord and nerves has recovered sufficiently to get about comfortably and has been back at her work since six months after her accident.

Case IV had no signs of damage to cord or nerves. The primary reduction (?) relieved her local pain on respiration, and her dysphagia which did not return with recurrence of the deformity. She is now perfectly well except for fusion of her two vertebræ in distorted relations.

SUMMARY

Fracture dislocation of the neck is increasing in frequency because of motor accidents.

Etiology—Hyperflexion of spine due to indirect violence, falls on head or buttocks, weights falling on head, diving accidents, etc.

Pathology—Bone and associated structures. Dislocation of bone with more or less comminution, tearing of ligaments and muscles. Damage to intervertebral disc. Pressure absorption of disc and erosion of damaged vertebræ where in contact. Final ossification between the damaged vertebræ.

Cord—No damage at all, contusion of varying degree, or complete division of cord. Leptomeninges usually damaged. Dura usually escapes. Oedema occurs in a few hours if cord is damaged and if sufficient to fill the unyielding dural canal tightly will cause degeneration of the cord. If bony distortion continues pressure of the cord against prominent bone will cause transverse myelitis.

Nerve Roots—Usually contused between the two involved vertebræ, and if pressure is not relieved degeneration may occur.

The amount of dislocation does not determine the degree of primary injury to the cord. There may be marked dislocation with no signs of cord or nerve injury, or slight dislocation with serious cord injury.

Differentiation must be made between signs of nerve root injury and cord injury. Usually both are present at the same time.

Diagnosis depends on the history of the accident, the local signs in the neck, including evidence of lateral films, and signs of lost cord and nerve function.

Treatment—Primary operation is contraindicated. Cases developing signs of beginning pressure myelitis after fusion of the vertebræ in bad position require spinal decompression.

Reduction by the method presented is simple, safe and efficient.

Systematic physiotherapy is indicated.

Fixation is best continued until ossification between the two vertebræ has occurred. This minimizes the absorption of disc, the erosion of vertebræ and consequently the ultimate angulation of the spine.

Results—In form and function, considering the type of cases, seem good.

OBSERVATIONS ON IMPAIRED SHOULDER FUNCTION AND METHODS OF TREATMENT *

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I HAVE chosen the shoulder for a subject because it has been a joint of especial interest to me. This interest started with a feeling of compelling ignorance, and after attempting to study the joint's many vagaries, I feel that I have, perhaps, gained a small insight into some of its many problems. Larger acquaintance, however, has revealed not only how profound was that original ignorance, but how little I have learned to combat and cure its impaired function.

I disclaim presenting anything which I consider new, but rather an attempt at coordinating some clinical observations which I have made. Some of these observations, I feel, have been most helpful to me in understanding impaired shoulder function, in preventing it, and in some cases aiding in recovery.

I purpose to deal with the scapulohumeral joint principally, and the scapulothoracic joint, if I may be permitted to use such a term for purposes of discussion, only insofar as is necessary to formulate a basis for discussion. I do not purpose to deal with the joint according to the time-honored formula now current for description of disease. I am going to deal with generalities to a large extent, and certain specific factors which have to do with anatomy, physiology, physiological pathology, pathology, and treatment. Accurate details of the pathology of many of these conditions are unavailable.

The shoulder-joint is affected with all the pathological conditions that any joint is subject to, and also some that others are not apt to have, due to relationship of other structures involved in its function.

The pathological changes in a shoulder-joint are in almost every respect the same as occur in any other joint, and the treatment of these lesions is essentially the same as joint lesions elsewhere, with minor exceptions, based upon the anatomical arrangement peculiar to it.

Complete destruction of the shoulder-joint with ankylosis, if this is in a good position and complete, is not as disabling as one might at first believe. If this is elected and determined by a surgeon for adequate cause, the result is not disappointing. The conditions which lead to this are familiar to all, and the pathology, gross and microscopic, are well known. On the other hand, there are a large number of conditions, the pathology of which is not known, because they are not of such gravity as permit their study by operative procedures. Many of these conditions do not have sufficient gross changes to be apparent by our present powers of observation, nor to allure the pathologist.

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nor do they appear of such importance as to arouse any special enthusiasm in investigators who might help clarify the cause. You all have seen pain, suffering, disability, and economic loss from impairment of shoulder function, of such degrees as would warrant more attention to the problem than is usually afforded the individual patient.

The shoulder or scapulohumeral joint is the proximal end and centre of rotation of one of the longest levers in the body. The joint, by reason of its ball and socket character, has many extensive movements. The long humeral member is attached to the scapula which is a relatively short and freely moving bone with extensive surfaces for muscular attachments. The capsular ligament which unites the two bones is a tubular investment of the joint with strengthening reinforcements. It is of such length that, unsupported by muscular action, the joint surfaces can be separated a distance of almost an inch.¹ This redundancy is necessary to permit the extent of movement that can take place in the arm. The function of the ligaments is to stop extremes of movement while still keeping the articular surfaces together, but does not in any way determine the specific direction within the normal movements of the joint. The insertion of the capsular ligament and muscles determines a centre of rotation of the arm at a point in the head of the humerus, which roughly makes for an extremely short-balanced lever of the first and third class, upon which the activating muscles must exert their pull. The great difference in length of the proximal lever and the distal lever bring about factors which are most important.

The work done by the muscles moving the shoulder-joint is very great in even lifting the arm. By reason of the large amount of work they have to perform due to this arrangement, any added weight in the hand which has to be lifted increases their work, and places upon their bodies and insertions really tremendous strains or *vice versa*, as when the body is lifted in the "chinning" feat of the athlete. The degrees of these strains should be considered in relation to the amount of pressure they cause upon painful peri-articular lesions. Codman² has placed the fulcrum of this long and short lever as a gliding one in the glenoid fossa.

With the body standing erect, the upper limb hangs at the side, but if the body is bent forward with relaxed shoulder muscles, the limb hangs as a pendulum, it can and will swing as would a weight suspended by a string, if the body is swayed. This entails no muscular action of the shoulder muscles except suspension support. With the body in the horizontal position, the limb at the side, as when a patient is lying in bed, the pendulum character of the lever is lost. In this case any voluntary movement of the limb necessitates the lifting, support, and movement of a long and heavy lever by a very short one. One must visualize the fixation group and the activating group of muscles, each of which is put under a great strain by movements of the upper limb in this position. If the upper limb is abducted with the body in the upright position, one can readily see that the working strain of the muscles starts at practically zero. As the limb passes through the arc of abduction to

IMPAIRED SHOULDER FUNCTION

the horizontal, the working strain upon the muscles is progressively increased until at the horizontal position the work of maintaining elevation is greatest, and the associated strains are greatest at the shoulder, and on the short lever. Where muscles are affected by an atrophy of disuse, and have lost their efficient contractile power, it becomes apparent that, as the work increases, the muscles have to work at an increasing disadvantage from two sources, an increasing weight, and diminishing efficiency. So much for the lever of the limb. I will deal with the muscle quality later.

The scapula furnishes an indirect attachment for the bones of the upper limb to the trunk through its articulation on one hand with the humerus, and on the other by its clavicular and muscular attachments to the body. When the normal shoulder reaches the horizontal in abduction, the scapula and humerus become essentially one, and the scapula then takes on the part of the short proximal lever, and by this substitution much greater leverage is secured for the use of the muscles moving the limb. The buried position of the scapula under soft tissues is a great disadvantage in many ways. The casual examiner is apt to overlook the fact that movement in certain directions of the upper limb may be made with the scapulohumeral joint quite fixed. To one seeking to determine the amount of movement in the latter joint, or to increase its function by muscular stretching, the scapula affords very little for the hand to grasp. This is quite in contrast to joints where there is a long bone proximal and distal which can be easily grasped to produce passive movements or register degrees of function.

The scapulohumeral joint is a true joint, has articular cartilages, ligaments, etc., and has the protective mechanism as stated by Hilton, who uses the circumflex nerve as an illustration of his law which is "The same trunks of nerves whose branches supply the groups of muscles moving a joint furnish also a distribution of nerves to the skin over the insertions of the same muscles, and the interior of the joint receives its nerves from the same source." In this way, he explains the fact that an inflamed joint becomes rigid, because the same nerves which supply the interior of the joint supply the muscles which move that joint.¹ As the nerve supply of joints also are distributed to the peri-articular structures, peri-articular lesions will act in the same way as intra-articular ones.

A painful intra-, peri-, or extra-articular lesion of the shoulder will produce a protective spasm of the muscles controlling its movements. If this spasm is maintained, the muscles develop contracture. Pain causes muscle spasm, muscle spasm produces more pain, hence more muscle spasm. The vicious cycle is broken by overcoming the spasm in the muscle by traction.

The scapulothoracic joint is not a joint, as it has none of the structures which enter into joint formation, neither has it this protective mechanism, although the movement between the scapula and chest wall is far greater than that of many joints in the body.

I turn now to the muscles which enter into our picture. These, I believe, are the great, if not the greatest, factors in the impaired shoulder function.

Muscles are of little use in activating an ankylosed joint, but they are of great service to the impaired joint. As it is with the latter we are dealing, the importance of preserving muscle function for the purpose of aiding in the preservation and restoration of disturbed function of the shoulder is of prime importance. Many of the principles applied to the shoulder-joint seem to hold good for most other joints in the body to which I have had an opportunity to apply them.

An intra-articular, peri-articular or extra-articular painful process in or near the scapulohumeral joint will, through the joint's protective mechanism, put the muscles moving this joint into spasm, but not those of the scapulothoracic joint, as the latter has no protective nerve mechanism. This may be voluntary, but is mostly involuntary. When this spasm is maintained for a sufficient period of time, the muscles in spasm go into contracture. Muscles which are not under traction, or whose normal tone is not overcome by their antagonists, or are not kept in voluntary movement even to a slight degree, tend to develop this contracture. A simple and familiar illustration is the dropped foot of the polio case, or the plantar flexion of the foot in improperly treated cases of fracture of the femur or leg.

I am led to believe that muscles about the shoulder-joint, in a state of contracture, are painful, though I know of no other example in the body. The reason for this pain, I have not been able to explain to my satisfaction. The best explanation I have is, that it is a myositis of some form, but I feel most certain, from my observations, that the pain which accompanies muscle contracture about this joint is relieved by stretching these muscles to the proper degree. If the contracture is causing pain when these muscles are restored to normal, or near normal length and function the pain is usually gone. This of course premises that the original condition which instituted the contracture has been cleared up.

An example of the extra-articular lesion is the stiff shoulder that is left after a Colles's fracture, where there has been no injury to the shoulder, but the patient has endeavored to immobilize the forearm by splinting the shoulder.

The best example of a peri-articular lesion is the simple, acute, sub-acromial bursitis which, if given rest by appropriate treatment, leaves no after effects, but if the patient has to prevent movement and pain in the shoulder by muscle spasm, when the bursitis is well, an impaired shoulder is left from muscle contracture with pain referred to the insertion of the deltoid.³

One of the common causes of impaired function of the shoulder is the treatment of fractures of the humerus in a way that maintains the humerus at or near the side of the body. Treated in this position, the adductor group of muscles develop atrophy of disuse, and also go into contracture. The elevator group, deltoid and supraspinatus, develop atrophy of disuse also, but not contracture, as they of necessity remain at their extreme length.

When one compares the relative bulk or cross-section of the muscles which hold the arm at the side, and which are shortened, with the cross-section of

the group of elevators which are atrophied and long, it is seen that cure is handicapped at the start. Movement to a slight degree of the adductors in a sling will restore their quality rather quickly, but not necessarily their length, because there is nothing to pull against them, whereas the elevators have length and are not contracted and have rather infrequent activity to restore their quality. When they do act they act against the more powerful short adductors and gravity, together with the superimposed disadvantage of the lever principle spoken of before.

When the arm has been held in abduction with or without external rotation, the reverse of this condition exists. The elevators are contracted, the adductors are lengthened, and when the arm is released from its outside support, gravity exerts a beneficent action and the long lever and weight of the arm is an advantage in stretching the elevators.

In examining cases of impairment one will notice that there is a certain range of motion in the joint of a few degrees in certain directions. This seems to be brought about by the natural position of repose of the arm during treatment for shoulder or other lesions. If the forearm rests against the body, the latter prevents internal rotation, and the slight amount of abduction present does not permit the humerus to be abducted sufficiently to develop any more. There are usually a few degrees of external rotation and abduction, and extension forward. The presence of this small amount of movement without pain, in different directions, is very helpful in differentiating between muscle and bone fixation, and intra-articular changes. This slight movement appears to be maintained by true muscular activity in a zone of small size which has a minimum of pain. Recovery is manifested by an enlargement of this non-painful zone and appears first in the direction of movements of necessity and frequency.

Ligaments are for stopping extremes of motion and guiding fixed movements. The shoulder-joint is devoid of ligaments for guiding fixed movements. Fixed movements are determined by groups of muscles so coordinated as to determine movement of the arm in fixed planes, thus acting as guiding ligaments. The planes in which arm motion at the shoulder takes place are almost infinite. This necessitates that there must be an infinite number of positions which the muscles assume to allow and determine the planes through which the arm passes. For the arm to make a movement in any plane, one has to conceive that there is a group of muscles acting as fixation muscles, and a group of muscles acting as activating or movement muscles. I use these terms which are relative only to aid in forming a concept as to any movement of the shoulder-joint. All the muscles must act, but those producing the movement in any non-curving plane must of necessity contract and extend to a greater degree than the muscles which are determining the position of the plane of movement. This aids in visualizing movement in a non-curved plane but the shoulder-joint is capable of movement in not only simple planes, but curved ones.

When movement in a curved plane takes place, one can readily see that a

more complex action occurs. As a simple example, where the arm is abducted to the horizontal, leaving out the action of the scapula, it is raised by the deltoid and supraspinatus contracting, while the muscles which ordinarily depress it, subscapularis, pectoralis major, latissimus dorsi, teres major, are relaxing to permit the upward movement. At the same time these muscles are acting, the plane of motion is determined by the other group of muscles acting as guiding ligaments, and in this instance a portion of the guiding or fixation muscles are aiding in the work as movement muscles. In other words, there are muscle groups which during movement of the arm in one plane act like the lateral ligaments of a joint which has only one plane of movement. The next instant these same muscles have given up their fixation function and are acting as the groups which move the limb in an entirely different plane. If one will visualize vertical and horizontal planes of movement of the scapulohumeral joint at right angles to each other, one can readily appreciate that in circumduction through various angles or curves, there is a gradual transition in the action of these two contrasted groups of muscles at every degree of the arc of movement. This calls for a coordination between the group contracting to make the greater part of the movement, its antagonists and the groups acting in the movement as fixation muscles or ligaments, each taking on the work of the other as the action progresses. In circumduction the complexity of this coordinating mechanism and its swiftness of action in rapid movements, as pitching a ball, is a thing to marvel at, especially when the direction of the pitch is under control. In a joint of such complex mechanism, a slight degree of contracture will interfere very quickly with function.

With the above principles in mind, it remains to use them if we can to prevent conditions which may arise in proximity to or outside the shoulder which tend to impair its function. To make use of these principles in preventing prolonged stiffness of the shoulder, one has to divide the problem into several classes.

A temporary extra-articular process distant from the joint in which the patient aids the comfort of the afflicted part by holding the shoulder in spasm to immobilize the limb, requires that the painful process be adequately splinted and the forearm be supported by a sling, that the patient be instructed to elevate the limb to its full vertical position as many times daily as is necessary to prevent contracture of the shoulder developing from protective spasm. This class includes infections of the hand and forearm, fractures of the same, certain processes in and about the scapula, as bursitis and spurs.

In peri-articular lesions in proximity to the scapulohumeral joint which are painful and produce as much pain and spasm as intra-articular ones, a choice of procedures is afforded depending upon the severity, duration, and disability of the process. These measures are either ambulatory or non-ambulatory. Distinctive of this type are the acute inflammations of the bursa about the joint or the unexplainable lesions which cause the "irritable shoulder of Lovett."

I use for the treatment of these a simple bandage sling, large axillary pad,

IMPAIRED SHOULDER FUNCTION

and encircling swathe which embraces arm, body, and sling If spasm has been instituted by the time I first see the case, and it is causing pain which can usually be determined in the examination by the relief afforded by holding the wrist in one hand and exerting gentle traction on the humerus, I use a form of ambulatory traction in conjunction with the sling, pad, and swathe (See Fig 1)

In certain cases where the trapezius muscle has become too irritable, this traction is contraindicated The weights used in this form of traction must be proportioned to the musculature of the shoulder, usually a pound or two is sufficient If the weights are too heavy, they will bring about pain in turn This traction is arranged so that gravity is used by day, and a traction weight at the end of a cord acting through a pulley on the foot of the bed, is used at night (See Fig 2)

For patients confined to bed this form of night traction is very desirable and comforting A patient sitting or walking usually has comfort by day from the weight of the arm acting as traction, while his nights are miserable due to his attempts to move a long heavy horizontal lever by a short painful one Where existing conditions necessitate that the treatment be non-ambulatory, or in treating cases of fracture of the greater tuberosity, or non-impacted ones of the surgical neck where abduction is indicated, as emphasized by Santee, I use the overhead suspension of the forearm, and traction on the arm with it in abduction

I recently have treated a fracture of the clavicle in a temperamental actress by abduction with traction, and found that she could not stand the traction after a ten-day period The abduction was continued, but when this was removed she had quite marked contracture which lasted for an appreciable time, whereas a comminuted fracture of the clavicle treated previously by this method proved quite effective and satisfactory

These contrasts demonstrate that the question of treatment in my mind is still unsolved The group of cases one sees where the primary trouble which initiated the contracture has cleared up sufficiently for the pain of the primary lesion to have disappeared, but has left the shoulder with a loss of function, and in some cases pain from the secondary process requires more consideration

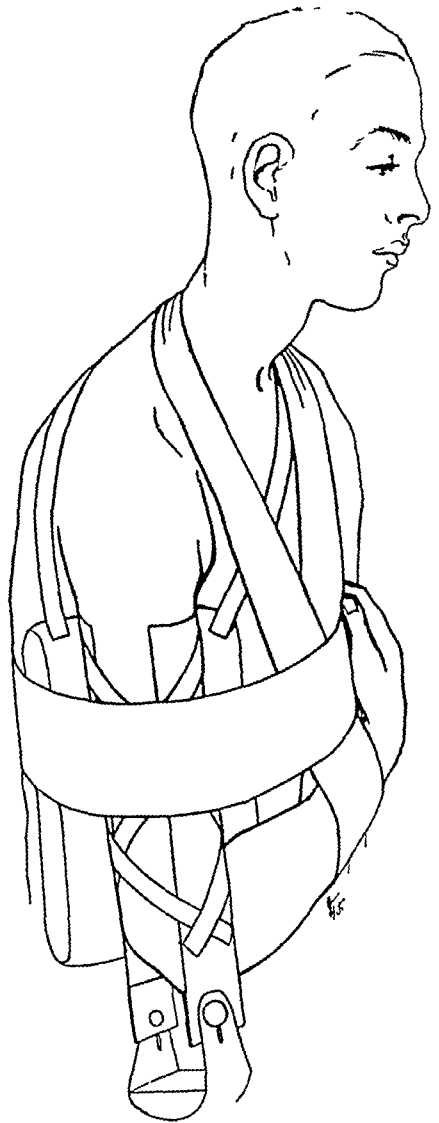


FIG 1—Showing axillary pad, sling and swathe, together with arrangement of traction weight attached to traction straps by buttons and button holes, for use in walking about

The diagnosis is made on a careful history and examination. The movements should be very slow and gentle. The scapula should be steadied with one hand while the other grasps the elbow and rotates the humerus gently. If there is any motion in the scapulohumeral joint the degrees of free painless movement existing in all directions should be compared with the normal side. Presence of this motion tends to exclude ankylosis.

The examination should include having the patient turn his back to the examiner, then abduct and elevate both arms as the examiner holds the lower angles of the scapulae between the thumb and index fingers. This contrasts the action of the scapulohumeral and scapulothoracic joints of both arms.

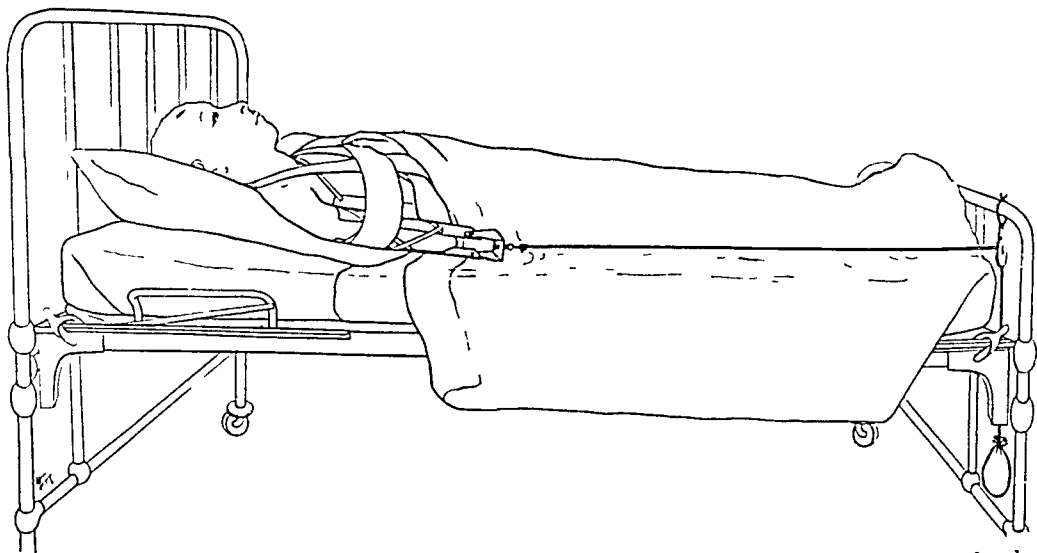


FIG. 2—Showing same arrangement as shown in Fig. 1, with pulley and weight substituted for day weight, when patient is lying down. The buttons facilitate this change.

simultaneously. In the examination of the patient, if there is any abduction present, resisting this movement as it is made with slight pressure by the examiner will necessitate that the patient involuntarily fix the scapula before he can exert any antagonistic pressure. In these cases pain is usually referred to the site of insertion of the deltoid. If traction on the elbow relieves this pain, it is significant that it is caused by muscle spasm or contracture. The patient is placed in the supine position on the examining table, the anterior border of the scapula is fixed with one hand while the arm is very gently and as slowly as possible moved in a sagittal plane with the forearm flexed over the operator's forearm. This is painful and should be done for diagnosis to a very slight degree only. This tells the operator degrees of movement, whether the muscles stretch at all, and if they do, how much, the degrees of resistance of the muscle and the muscle's quality. There may be very definite movement in certain directions, as mentioned before, greater than in others, and it can be determined easily that movement is limited by muscle contracture.

When the history and X-ray exclude articular or marked peri-articular bone changes, together with the examination confirming that loss of function is due to muscle contracture alone, part of the treatment is by gentle stretching of the contracted muscles. This should be done once or twice a week by

the surgeon, and must be done in the direction of the normal movements of the shoulder. The range should be done just beyond the point of pain, and care should be taken not to go too far, or a bad reaction will occur. The movement must be done so slowly that it is barely appreciable, to satisfy a physiological law.⁴ The patient must be directed to relax, and this is a difficult thing to accomplish. If the surgeon feels the muscles giving, followed by a slight contraction of the muscles, which will cause pain, relax the muscles by retracing the movement a few degrees, until spasm ceases, then proceed. Many times slight crepitation will be felt as if something has given away. The operator should endeavor to maintain traction on the humerus while performing these movements. The arm should be returned to the position of repose not too fast, and then traction on the humerus for a few moments will relieve the pain and give the patient confidence to permit stretching in another direction. These movements I have never done under an anæsthetic, as in one of Codman's early papers,² he called attention to the great damage and disability produced by doing too much.

The reaction to stretching should be very moderate pain at the time it is done. This should not persist, but leave a slight soreness which passes away in a few hours, while the pain at the insertion of the deltoid, in the neck, and down the arm is usually improved together with slight improvement in the function of the joint.

In the treatment of the contracture of any group of muscles of any joint without bone changes, in which there is some movement, resisted movements in the direction of the plane in which movement has been lost will tend to restore function by developing the muscle or muscles which produce it by contraction, and at the same time will by coordinated syneigistic action tend to relax the antagonists. As movement develops in the joint, resisted movements following this dictum will be of material aid.

Exercises at home in conjunction with the above are swinging the dependent arm by body movements, as a pendulum, with the body bent forward at the waist. These should at first be within the point of pain, then slowed to require voluntary muscle movement of scapulohumeral muscles. Small weights may be used later, and control of scapular action by an attendant is desirable. Wall climbing by the fingers and hand, or climbing a small suspended ladder by the fingers, using the muscles of the forearm only and making little attempt to use the elevators until they have gained some of their contractile power. When the hand has reached an elevated position, it can then be used as a fulcrum to stretch the adductors. The arm should not be dropped quickly to the side after this movement, but returned slowly to prevent reflex protective spasm.

The principle of stretching the shoulder by elevating the hand by a cord and weight acting over a pulley is excellent as a means of stretching contracted muscles, but the contracted muscles should not be permitted to pull the weight back. This principle can be used to give resisted movements in various directions as the best adjuvant to the stretching.

In cases in which it is desirable to aid the group of elevators or abductors to develop by active movements during a minimum of work, I have the patient lie down on his back, the arm is then suspended in a sling supporting the weight of the arm as it rests at his side. The suspension point of this sling must be high to give the sling a long arc of movement. The patient then can move the arm laterally, or abduct it without having to support its weight.

For the pain that is present in so many of these cases that they are frequently diagnosed as neuritis, I find aspirin and phenacetin combined most helpful.

Local Measures—Nothing in my experience compares with hot moist stupes, applied very hot over the whole shoulder and upper arm for twenty minutes each day.

Massage Is Next—This must be given with the greatest gentleness to the painful cases, and not too frequently. I have seen these cases made distinctly worse by what the masseuse thought was "gentle massage." Massage should be given after the moist heat. Massage is best given every other day. Dry heat comes third in efficiency for pain.

Electricity—In the form of diathermy has been disappointing to me, though I am still open to conviction and am still trying it.

Recovery from the shoulder disabled by muscle contractures is so slow and tedious, that anything which can be done to prevent it should be instituted early. Although I attempt to do this in every case which I anticipate may develop this condition, and keep it constantly in my mind, and although I believe I avoid a great deal of trouble, I cannot secure perfect results in all cases. One understanding these principles and making use of them, I believe, can restore function more quickly to a shoulder than where they are not used.

In the course of treatment, I have found the following very trying. Non-cooperative patients, ignorant patients, rheumatic tendencies, weather changes, occupational strains, and find one has to adjust and arrange the administration of treatment according to the reactions that develop from these factors.

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INJURIES TO THE ABDOMINAL VISCERA

THEIR RELATIVE FREQUENCY AND THEIR MANAGEMENT*

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THERE are two types of injury to the abdominal viscera. *First*, those produced by direct trauma such as blows, falls and automobile accidents, *secondly*, those resulting from penetrating objects such as gunshot and stab wounds. This latter group will not be discussed in this paper, as it is generally agreed that this type of injury needs immediate surgical attention. In the cases of traumatic abdominal injury one is confronted with making a differential diagnosis between (1) Retroperitoneal hæmorrhage, (2) intra-abdominal hæmorrhage, (3) rupture of a hollow viscus. On the Fourth Surgical and the Children's Surgical Service at Bellevue Hospital there have occurred, during the past nine years, fifty-three cases of injury to the abdominal viscera. These injuries will be grouped under the three headings just given.

Retroperitoneal Hæmorrhage—There are two causes of retroperitoneal hæmorrhage. First, ruptures of the kidney, accompanied by retroperitoneal hæmorrhage, which have resulted from laceration of the kidney substance. Second, cases of retroperitoneal hæmorrhage, which have resulted from injuries to the retroperitoneal tissue without a kidney lesion.

Ruptures of the Kidney—This series included eighteen cases, seventeen of which were not operated upon, and sixteen of the seventeen cases were cured. The average stay in the hospital was thirteen days. One patient, seventy-four years of age, with a fracture of the right radius and ulna, a fracture of the fourth cervical vertebra, and a rupture of the left kidney, was not operated upon and he died twenty-four hours after admission. There was one operative case, a child, ten years of age, who had fallen four stories and had received a compound fracture of the right humerus and abdominal injuries. Operation revealed a laceration of the right kidney with retroperitoneal hæmorrhage. Nephrectomy was done and the patient died twelve hours later. One case in this group, a boy, nineteen years of age, having fallen down an elevator shaft, received a fracture of his right wrist, right ankle, and a rupture of his right kidney, and forty-eight hours after admission his abdomen became distended and rigid and his complaints were referable to his abdomen. Conservative treatment was followed and forty-eight hours later his abdominal symptoms disappeared and the patient made an uneventful convalescence.

* Read before the Medical Association of the Greater City of New York, April 15, 1929

Retroperitoneal Hæmorrhage without Kidney Injury—This series included two cases, one patient being a child, twelve years of age, who had been hit by an automobile. The urine findings were negative. A diagnosis of intra-abdominal injury was made and laparotomy performed, disclosing a retroperitoneal hæmorrhage without hæmorrhage in the abdominal cavity. An uneventful recovery followed. The second case was that of a child, five days old, who had been a difficult breech extraction with Erb's palsy of the left arm. Examination revealed a mass the size of a lemon in the right side of the abdomen. There was no visible peristalsis and on rectal examination the mass could not be felt, nor was blood detected. A pre-operative diagnosis of intussusception was made and on opening the abdomen the right kidney was found torn loose with a retroperitoneal hæmorrhage. The peritoneum had been torn posteriorly and some blood clots, about a cupful, were present in the abdominal cavity without active bleeding. The abdomen was closed in layers and the patient died two hours later.

Cases of retroperitoneal hæmorrhage may produce symptoms simulating abdominal hæmorrhage, or the rupture of a viscus. In making a diagnosis it is very important to consider the site of injury, and if the injury has been over the kidney, or lumbar region, one should suspect a retroperitoneal hæmorrhage as a most logical diagnosis. Of course, if there is hæmaturia one can be more certain of the diagnosis. Apparently, the retroperitoneal hæmorrhage stimulates the sympathetic nervous system causing a paralytic ileus with the symptoms referred to the abdomen. In cases of rupture of the kidney, or in retroperitoneal hæmorrhage without kidney damage, conservative treatment is the treatment of choice.

Intra-abdominal Hæmorrhage—There are usually two causes for hæmorrhage in the abdominal cavity. It is due either to rupture of the liver or to rupture of the spleen.

Ruptures of the Liver—There were seven cases of rupture of the liver in this series, and of this group four were operated upon, with two deaths. In the operative cases no active bleeding was found at the time of operation, but the abdomens were found full of blood clots. In the two cases that died, each had a pre-operative diagnosis of ruptured liver. One patient, thirteen years of age, was admitted in marked shock, with a blood pressure of 60. A transfusion of 250 cubic centimetres of blood was given and the blood pressure raised to 90/60. The patient was operated upon and blood pressure fell to 64. There was no active bleeding at the time of operation and he was transfused with 400 cubic centimetres of blood immediately following operation and the blood pressure was again raised to 90, but the patient died twelve hours later. Another patient was a man, forty-five years of age, in moderate shock with pre-operative diagnosis of rupture of the liver. An exploratory laparotomy was performed, but no active bleeding was found at the time of operation and the patient died ten hours later. There were three cases which were not operated upon, two of which lived and one died. One patient was a child, seven years of age, who had been struck by an automobile, and was in marked shock with thready pulse and board-like abdomen. The patient had projectile vomiting and dulness over the right lower quadrant. A diagnosis of ruptured liver was made and the patient was not operated upon. After three days his abdominal symptoms had mostly disappeared. He remained in the hospital ten days and was discharged cured. The second case was a man, thirty-two years of age, who had been

struck in the abdomen. He stayed in the hospital four days, but went home at his own request, with instructions to remain in bed. The patient returned in two weeks with a swelling in the region of the ninth rib. He was operated upon and found to have a hæmatoma with a laceration of the liver. An uneventful recovery resulted, the patient leaving the hospital on the seventh day. The case that died was a child, three years of age, in extreme shock, who died one hour after admission. Post-mortem examination revealed a rupture of the liver, of the left kidney, and of the spleen.

Ruptures of the Spleen—This series included eight cases with three cases operated upon, all of which lived. One patient, twenty-eight years of age, admitted twelve hours after having been struck in the left upper quadrant by a policeman's night stick, came in complaining of pain in the left upper quadrant. A diagnosis of injury to an abdominal viscus was made. The patient was operated upon twenty-hours after the injury. The abdomen was found filled with blood clots and the spleen ruptured, but no active bleeding at the time of operation. Splenectomy was done and the patient recovered. The second case was that of a man, thirty-five years of age, who had been intoxicated and did not know what had happened to him, but he had been injured in some way the night before. He was admitted fifteen hours after his alleged accident with pain and rigidity, chiefly on the left side of the abdomen. A diagnosis of injury to an abdominal viscus was made. An exploratory laparotomy was performed, the abdomen found full of blood clots and the spleen ruptured. There was no active bleeding at the time of operation. Splenectomy was done and the patient recovered. The third case was that of a boy, thirteen years of age, who had been hit in the left upper quadrant by a baseball bat. He was admitted to the hospital immediately, in shock, and an emergency operation performed, the spleen being found ruptured with active hæmorrhage. Splenectomy was done and the patient cured. There were five cases not operated upon, all of whom died, but in each case there were multiple injuries. One patient, eight years of age, suffering from a fracture of the left femur and of the right humerus, died a few hours after admission. The second case, three years of age, in extreme shock, died a few hours after admission. Post-mortem revealed a rupture of the spleen and diaphragm. The third case was a man, fifty years of age, alcoholic and in extreme shock, who died twelve hours after admission. Post-mortem examination revealed a ruptured spleen and left kidney, retroperitoneal hæmorrhage and, also, a fracture of the sixth and tenth ribs on the left side. The fourth case, a boy, nine years of age, in marked shock, died a few hours after admission. Post-mortem examination revealed a rupture of the spleen and kidney. The fifth case, a child, three years of age, died thirty minutes after admission. Post-mortem revealed a ruptured liver, spleen, and diaphragm.

Hæmorrhage in the Gastrocolic Omentum—This case was a man, twenty-five years of age, with a history of having been struck in the abdomen by a blackjack twenty-four hours before admission. Next day he complained of pain in the abdomen and was admitted to the hospital and operated upon for a rupture of an abdominal viscus. The patient was found to have a hæmorrhage in the gastrocolic omentum, with no evidence of injury to other abdominal organs or active bleeding at the time of operation. Six days after the laparotomy the patient eviscerated, was resutured and died two days later.

In cases of intra-abdominal hæmorrhage one is aided in making a diagnosis if a history can be obtained as to where the blow was received, as will be noted in ruptures of the spleen. In most of the ruptures of the liver the patient complained of pain in the right upper quadrant, which frequently was accompanied by fractures of the ribs on the right side. One should always try to detect the presence of liver dulness, as this is one of the aids in differentiating between intra-abdominal hæmorrhage and ruptures of a hollow viscus.

Treatment—In ruptures of the liver conservative treatment is more desirable than an exploratory laparotomy, as surgery is of no avail in ruptures of the liver, for usually the hæmorrhage has stopped and is started again by the surgical intervention. In ruptures of the spleen I think that one can see from this small group that two of these cases would have made an uneventful convalescence if they had not been operated upon, as the hæmorrhage had stopped before operation, the injury having occurred twenty-four hours before. I cannot help but feel that these patients should not be operated upon immediately, but should first be treated for shock and their general condition watched, and a laparotomy performed if their condition demands same.

Ruptures of a Hollow Viscus—In these cases one is dealing with a rupture of either the intestine, the bladder or the stomach.

Ruptures of the Intestine—There were twelve cases in this series, and of this group two patients were not operated upon, one being a man, sixty years of age, in extreme shock, who died fifteen hours after admission. Post-mortem examination revealed a rupture of the small intestine and fracture of the base of the skull. The second case was a woman, forty years of age, who had been struck by an automobile twenty-four hours before admission. She was treated by a private physician and referred to the hospital twenty-four hours later and died a few hours after admission. Post-mortem examination revealed a rupture of the jejunum, fractured tenth left rib and laceration of the pleura. There were ten cases that were operated upon, three of which lived and seven of which died. Of the three cases that lived, two had been injured twenty-four hours before operation, and in all three cases the rupture was found in the ileum. Of the seven cases that died, all were admitted and operated upon immediately. Ruptures were found in the transverse colon in one case, in the jejunum in one case, in the ileum in four cases, and in another case the records merely stated small gut.

Ruptures of the Bladder—There were four cases in this series, with one cure and three deaths. One patient was a man, thirty-three years of age, who had been kicked in the lower abdomen by a horse. He was admitted to another hospital and discharged the same day, but after being discharged from the other institution he complained of frequency of urination and passing only a small amount of urine at a time. On admission to Bellevue Hospital he complained of pain, as well as frequency of urination. Examination revealed definite fulness over the left lower quadrant and only a few cubic centimetres of urine obtained on catheterization, with hematuria. A diagnosis of extraperitoneal rupture of the bladder was made and the patient was operated upon and a rupture found near the base of the bladder. A superpubic drain was inserted and a cigarette drain at the site of rupture. The patient made an uneventful convalescence, being discharged on the sixteenth day, with the suprapubic wound healed. Of the cases that died, one had a rupture of the bladder and small intestine, and a fracture of the skull, and was brought in unconscious. He was operated on forty-eight hours after admission and died twenty-four hours later. The second case was a man, fifty-six years of age, who had been intoxicated and did not know how he had been hurt, but complained of pain and swelling in the lower abdomen. He was operated upon and found to have a rupture of the bladder with diverticulum of same. The third case, forty-three years of age, fell down an elevator shaft receiving a fracture of the pelvis and a fracture of the transverse process of the lumbar vertebra. I saw this patient immediately on admission and suspecting a rupture of the bladder advised immediate catheterization, but this was advised against by a urologist, as he felt the patient had a cord injury. The patient was operated upon after twenty-four hours for a ruptured bladder, but he developed an extensive osteomyelitis of his pelvic bones and died ten months later.

INJURIES TO THE ABDOMINAL VISCERA

Ruptures of the Stomach—One patient, six years of age, was admitted to the hospital immediately after being hit by an automobile. An emergency operation was done and the patient found to have a rupture at the cardiac end of the stomach which was repaired by simple closure and the patient died a few hours later.

In the diagnosis of rupture of the intestine one is confronted with a very difficult problem, but if the injury has been directly over the abdomen without injury to the ribs or the pelvis, it should make one suspicious of a rupture of the intestine. One should try to detect the absence of liver dullness, and in these cases X-rays of the abdomen should be taken to determine the presence of gas. In cases of rupture of the bladder the location of the injury is of considerable aid, and if the trauma has been directly over the pubis, or if there is a fracture of the pelvis, one should be suspicious of a bladder injury. Of course, catheterization of the patient is important, particularly if the bladder is filled and the fluid is not withdrawn, or if bloody urine is obtained. It is well to remember that one can have intra-abdominal rupture of the bladder and the catheter inserted into the abdominal cavity and the same amount of fluid withdrawn as is introduced. Treatment of rupture of the intestine, of course, requires immediate surgical intervention, but one should be reasonably certain that he is dealing with a ruptured intestine before submitting the patient to a laparotomy. If there is a question of doubt, it is to the patient's interest to follow the policy of watchful waiting, rather than submit him to an exploratory operation.

In the treatment of rupture of the bladder one is justified, if in doubt as to the diagnosis, in making a suprapubic exploration, for this can be done under local anæsthesia without doing the patient any particular harm, while cystoscopic examination in these patients is very painful and shocking and does just as much damage as a suprapubic incision.

Injuries to the Chest Simulating Abdominal Injuries—I have not included chest injuries in this report, but I would like to call attention to the fact that ruptures of the lung, with pneumothorax, will produce symptoms which are referred to the abdominal cavity, and these patients are frequently explored with negative findings when at autopsy a correct diagnosis is made. This can be avoided if one makes a careful physical examination, or takes X-rays of the chest. Dr. Fenwick Beekman has stressed this point in a recent paper which is to be published, and I refer those who are interested to his paper.

Palliative Treatment of Abdominal Injuries—There is an element of danger in the use of blood transfusions in this type of case, particularly if the patient is given large transfusions of 500 to 800 cubic centimetres. Needless to say, the transfusion is given rapidly and the blood pressure is raised suddenly and in so doing the blood clots may be dislodged. If transfusions are employed the patient should not be given over 250 to 300 cubic centimetres at a time, and this may be repeated if necessary. On the Fourth Surgical Division at Bellevue Hospital we have been using, for the past year and a half, the gum glucose solution as used at the Woman's Hospital. This consists of 6 per cent gum acacia and 20 per cent glucose in 500 cubic cen-

timetres of saline, given at the rate of 4 cubic centimetres per minute, at a temperature ranging between 102° and 105°, or in other words, taking two hours to run in 500 cubic centimetres of the solution. This has given very satisfactory results and has a field of usefulness.

CONCLUSIONS

1 Cases of retroperitoneal hæmorrhage may simulate intra-abdominal injury, but with the aid of the history and the location of the injury, the diagnosis should be made. These cases, of course, should never be operated upon.

2 In cases of intra-abdominal hæmorrhage, if the hæmorrhage is due to a ruptured liver, conservative treatment should be followed, and in cases of rupture of the spleen the patient should be observed and treated for shock, and operated upon only if there are signs of continuous bleeding.

3 In cases of rupture of a hollow viscus, immediate surgical intervention is essential, but one should not submit these patients to a laparotomy unless he is certain of the diagnosis, as an exploratory laparotomy does not serve the patient's best interest.

ACUTE PANCREATITIS

AN ANALYSIS OF EIGHTY-EIGHT CASES WITH ESPECIAL REFERENCE TO DIAGNOSIS

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ACUTE pancreatitis can be diagnosed before opening the abdominal cavity. Fitz indicated that this abdominal catastrophe should be suspected when violent epigastric pain is followed by vomiting and collapse. These, however, are fulminating cases. The conception that acute pancreatitis can be diagnosed only at necropsy, or at the operating table, is no longer tenable. The possibility of acute pancreatitis, if borne in mind whenever an acute upper abdominal mishap presents itself, offers no greater difficulty in diagnosis than any other acute surgical condition.

Attention to the symptomatology of these eighty-eight cases herein reported may be of value in crystallizing the outstanding signs, the better to diagnose this condition. Early diagnosis leads to better prognosis, for in the two series previously reported,¹ the mortality rate dropped from 62 to 17 per cent. Seventy-five per cent of the latter group was diagnosed pre-operatively.

Etiologically, acute pancreatitis may result from (1) pyemic involvement, (2) by contiguity, (3) by lymphogenous extension, (4) retrogression of bile into the pancreatic duct, or (5) regurgitation of duodenal contents into the duct of Wirsung.

Pyemia seems to play little or no rôle, for early isolation of bacteria has never been accomplished. Extension by contiguity from gastric or duodenal ulcer may occur, but acute pancreatitis is very infrequently encountered with these changes. In our eighty-eight cases no mention was made of any pathological lesions in these organs, but the realization that many cases did not allow of complete exploration must be remembered.

Experimentally, the injection of enterokinase into the duct of Wirsung produced acute pancreatitis. However, the probability of this *modus operandi* must be exceedingly rare, notwithstanding the work of Williams and Bush. These investigators observed post-mortem dilatation of the biliary orifice as though it had been recently traversed by a stone. By dilating the biliary orifice of dogs by the passage of glass balls, they produced pancreatic necrosis. They concluded that regurgitation of intestinal contents may also be responsible for the production of pancreatic necrosis.

Infection of the pancreas via the lymphatics as propounded by Maugeret Ainspeger, and Deaver is based on the contention that the pancreatic lymphatics bear a very intimate relation with those of the biliary tract, secondly, on the fact that enlarged lymph nodes are found about the head

of the pancreas in acute inflammations of that gland, and, lastly, that anatomically regurgitation of bile into the duct of Wirsung can occur in but two of the four varieties of papillæ of Vater embryologically possible

The lymphogenous hypothesis carries with it the assumption, however, that infection spreads against the stream and directly through the lymph nodes. Infection does not run up stream, nor does it break the locks of lymph nodes. Experimentally, Archibald observed enlargement of lymph nodes by injecting bile into the duct of Wirsung. Swollen nodes would in all probability prevent the spread of infection from the gall-bladder to the pancreas and vice versa. Bartels maintains that no intervening lymph nodes connect the biliary passages and pancreas and Nordmann was unable to pro-

duce any pancreatic changes by introducing bacteria into the gall-bladder after tying off the common duct.

Retrojection of bile into the pancreatic duct resultant pancreatitis was first observed by Opie at autopsy. A small calculus had lodged in the diverticulum of Vater, thereby forming a common passageway of the ductus choledochus and the duct of Wirsung. Bile-stained fluid was present in the pancreatic duct, for the stone had prevented the

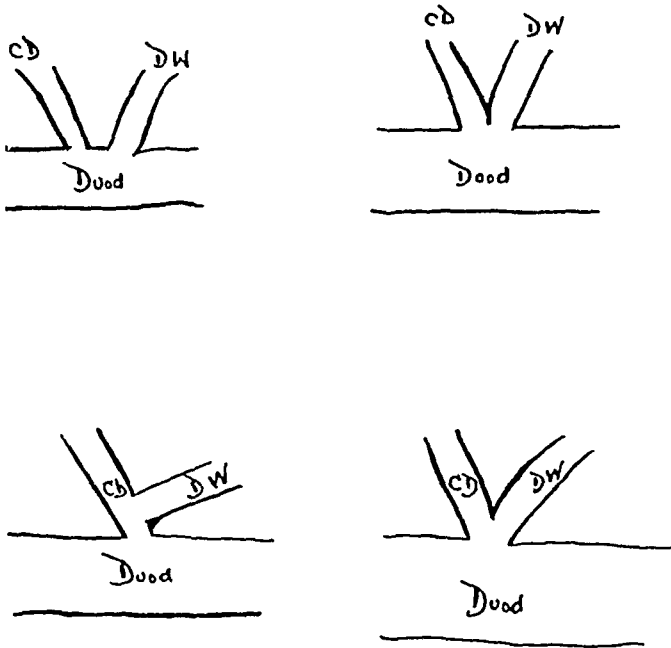


CHART I—Illustrates the four varieties of papillæ of Vater

influx of the bile into the duodenum. He then produced the disease experimentally by injecting bile into the duct of Wirsung. Infected bile he found more active than normal bile. Flexner showed that it was the bile salts that were the activating agents in the production of necrosis, and that mucus greatly inhibited the activity of bile. Infected bile induced fulminating pancreatitis.

Nevertheless, the mechanism of retrojection where no calculi were found in the ampulla still remained unexplained. Archibald showed that spasm of the sphincter Oddi could withstand pressure greater than that issuing from the biliary tract. Pancreatic lesions were produced by the temporary physiologic closure of the sphincter with spasmodic damming back of bile into the pancreas. Application of hydrochloric acid to the duodenal orifice of the ampulla produced prolonged sphincter spasm, so that fluids could be forced into the pancreatic duct by increasing the pressure in the biliary passages. This observer believes that bile frequently enters the pancreatic duct without

much damage To produce pancreatitis, bile must be infected, the proportion of biliary salts increased, or normal bile under considerably increased pressure Nordmann purse-stringed the ampulla with resultant jaundice and biliary tract dilatation, but produced no pancreatic involvement We may assume, therefore, to induce pancreatitis not only must bile be infected, but an increased biliary pressure must be counterbalanced by unusual sphincter spasm

Acute pancreatitis is not a primary disease, but rather a sequela Whether we favor one or the other hypothesis in its production, we must face the fact that biliary disease is usually the precursor It is more than mere coincidence that Egdall found biliary calculi in 50 per cent of his cases and 75 per cent complained of gall-bladder symptomatology As for the few cases in which no biliary pathological lesions or symptomatology was found, it is well to recall the work of Hess, who produced acute necrosis by tying the pancreatic ducts at the height of digestion, and that of Pratt, who did the same in fasting animals with no necrosis resulting

In analyzing these eighty-eight cases, we have taken fat necrosis as a criterion upon which the diagnosis was based It might be mentioned that acute pancreatitis with no fat necrosis resulting is a possibility, for we have encountered cases of acute pancreatic oedema with many other concomitant findings We deemed it advisable, however, to include only those cases in which fat necrosis was demonstrable

Females were affected in 88 per cent of our cases Our female-male ratio was the same in acute pancreatitis as in our gall-bladder disease, Reiser and Korte's observations to the contrary notwithstanding The former observed males predominating 79 to 42, the latter 30 to 14 If we regard gall-bladder disease as the important factor in the etiology of pancreatitis, males and females are alike affected

Fifty per cent occurred in the fourth and fifth decades, the youngest was nineteen, the oldest seventy

Previous gastro-intestinal disorders are of great significance All but eight gave some history of "dyspepsia", of these four had repeated alimentary disturbances for three to four weeks prior to admission Fifty-three per cent gave a definite history of biliary disease

Pancreatic symptomatology in its acute manifestation depends on the activation of trypsinogen into trypsin Digestion of protein by this liberated enzyme, whether it be blood-vessels, lymph-vessels, or pancreatic cells, all share in the catabolic process Pancreatic cells through digestion liberate lipase and, consequently, not only trypsin and lipase circulate through lymph channels, but their products of incomplete digestion as well

Symptoms are, therefore, due to local pancreatic irritation, as well as those due to the circulation of toxic products Inflammation of the pancreas results in oedema and swelling of that organ Stretching of the pancreatic capsule induces pain Diaphragmatic excursion may be obstructed Biliary

drainage into the duodenum impeded. Pressure on the abdominal brain should be taken cognizance of in explaining acute pancreatic symptomatology.

Circulation of foreign protein and its products of incomplete digestion may in part explain the severe toxæmia some of these patients present. Digestion of blood-vessels contributes the hæmorrhagic features to the picture. Inflammation of the peritoneum to the irritants circulating under its serosa depicts the reaction of this membrane and, finally, the whole picture *en masse* working simultaneously presents a definite clinical entity that can be recognized.

Symptomatology—Constant epigastric pain is most frequently encountered. Eighty-six of our series complained of epigastric pain, often described as splitting in character, as though something within were trying to force its way out. Some also complained of right hypochondriac pain, others of generalized abdominal pain. Ten had persistent backache. Backache was troublesome in fifty-eight of our cases. Left hypochondriac pain was present in thirty-seven cases.

CHART II
Pain in Acute Pancreatitis

Location	Number	Per cent
Epigastric	86	97
Hypochondriac, right	59	67
Backache (left lumbar)	58	66
Hypochondriac, left	37	41
Generalized abdominal	17	19

Pain in acute pancreatitis is of intense severity. Frequently, morphia in repeated doses fails to alleviate it. It is quite interesting to note that patients often volunteer the information that a hypodermic failed to ease their discomfort, whereas previously relief was immediate with one dose of morphia.

Vomiting is a very troublesome and persistent complaint. It is never progressive. Eighty-five of our eighty-eight vomited. Emesis is never fecal in character, and can usually be relieved by a single gastric lavage, thus differentiating it from acute intestinal obstruction situated high up.

Foreign protein injected into the circulation calls forth a peculiar train of symptoms which has been designated allergic. These at times predominate in acute pancreatitis. Shock, collapse, cyanosis, dyspnoea and in some instances dermatologic reactions, occur. Exactly how much pressure on the semi-lunar ganglion adds to the picture it is difficult to say, but these patients when seen early present an asthenia peculiarly characteristic of pancreatic disease. Cyanosis may in part be due to diaphragmatic embarrassment. Forty per cent of our cases were cyanotic. Seventeen were in shock on admission.

Temperature *per se* aids us not at all in the diagnosis, for in twenty-nine cases it was normal. In but eight did it rise above 102 degrees Fahrenheit.

ACUTE PANCREATITIS

Quite interesting, however, is the temperature-pulse ratio, for we observe that the pulse rises out of all proportion to the temperature elevation

Icterus due to pressure of the pancreas on the ductus choledochus is never severe. Twenty-eight were jaundiced and five others had bile in the urine, notwithstanding the absence of icterus in the scleræ or skin.

Peritoneal reaction due to the chemical irritants, trypsin and lipase, with their incomplete products of digestion circulating in the subperitoneal lymphatics, presents the same signs as peritonitis due to infection. This inflammation may be local or diffuse. Local peritonitis due to mechanical stretching of the pancreatic capsule by the œdema of that gland adds the local signs of tenderness to those due to the chemical irritant. Epigastric tenderness was present in 66 per cent of the cases and left costovertebral in 32 per cent.

Chart III reveals where tenderness was elicited.

CHART III
Tenderness in Acute Pancreatitis

Location	Number	Per cent
Epigastric	58	66
Hypochondriac, right	50	57
Hypochondriac, left	31	35
Costovertebral, left	28	32
Generalized abdominal	17	19

Constipation, and not diarrhœa, is the rule. The latter condition when present depicts a late manifestation, and one in which considerable pancreatic tissue has been necrotized. Constipation is not complete, of value in differentiation from intestinal obstruction. The silent parietic belly of acute pancreatitis offers a marked contrast to the one of mechanical obstruction in intestinal obstruction.

Other Symptoms in Acute Pancreatitis

Symptom	Incidence	Percentage
Cyanosis	58	66
Shock	17	19
Emesis	86	97
Abdominal distention	39	46
Jaundice	28	32
Urticaria	2	2.5

Every gradation of pancreatitis may be encountered. Three cases of different severity are cited below.

S. R., female, age twenty-three years, married, was admitted to the Jewish Hospital January 12, 1920 complaining of general abdominal and left lumbar pain. Pain started in the epigastrium and then radiated to the intrascapular region. Pain was associated with vomiting. The first attack occurred four months prior to admission. She had many minor attacks in the past two months. Since the birth of her child four months ago

the patient has experienced fulness and pressure in the epigastrium. Each attack was associated with dark-colored urine and light-colored stools. For the past four days the pain in the epigastrium has been knife-like, radiating to the back and intrascapular region, associated with feverishness and weakness and necessitated an injection of morphin. Three hours later the patient experienced a similar attack which required another hypodermic of morphia. She was admitted with constant dull epigastric pain and vomiting. The bowels have been constipated. In all, four injections of morphia were administered. Pain still persists, but is not as severe. Physical examination discloses cyanosis with an icteric tinge to the scleræ. Patient is rather anxious. Looks "all in," asthenic. Tenderness elicited in right hypochondrium and right iliac quadrant, left costovertebral tenderness, and epigastric tenderness, with the sensation of a mass in this area. On opening the abdomen there was a gush of beef broth fluid (serosanguineous). The gall-bladder was normal in size. It appeared normal. No stones. Omentum granular, swollen, œdematous with considerable fat necrosis. Parietal peritoneum studded with areas of fat necrosis. Section of omentum removed. Pancreas drained. Pathological report showed omentum contained areas of congestion surrounding areas of fat cells. Convalescence was uneventful except for three days of diarrhœa (eight to ten movements a day). Patient discharged in twenty-five days, recovered.

B. Z., female, age fifty-two years, married, complained of abdominal pain one year ago, had severe abdominal pain radiating to the back and shoulders, associated with vomiting, chills, and fever. Another attack ensued two months later. Attacks recently recurred every week or two. For the past month has had pain every other day. Vomited once on admission. On physical examination no icterus or cyanosis was present. Abdomen distended. Tender in epigastrium and left lumbar region. Temperature, 100.8° F. Pulse, 88. Respiration, 28. At operation the gall-bladder contained many small stones. The gall-bladder was thin. Small amount of beef broth escaped. Fat necrosis on omentum. On opening the gastrohepatic omentum, the pancreas was found swollen and indurated. Cholecystectomy with drainage resulted in recovery in seventeen days.

I. C., age fifty-five years, male, married, had epigastric pain for many years. He was admitted complaining of severe epigastric pain for twenty-four hours. Pain was present throughout the abdomen. Vomited three times. On examination patient presented a picture of shock and asthenia, skin cold and clammy. Abdomen distended and tender throughout. Marked left costovertebral tenderness. Cyanosis of face and extremities. Temperature, 98.2° F. Pulse, 112. Respiration, 30. At operation considerable beef broth fluid in general peritoneal cavity and lesser sac. Omentum granular with considerable number of fat necrosis. Pancreas enlarged, hemorrhagic, with large areas of necrosis. Pancreatic capsule incised and drained. Patient succumbed in twenty-four hours.

The diagnosis rests on the previous gall-bladder history which now presents a symptom-complex somewhat different than heretofore. Morphin no longer alleviates the pain, which now radiates from the epigastrium transversely to the left. The cyanosis, slightly icteric tinge of the scleræ or skin together with the peculiar asthenia and dyspnoea make the picture of acute pancreatitis. Tenderness elicited over the left upper quadrant and left costovertebral angle should aid greatly in confirmation of the diagnosis.

The differential diagnosis of acute pancreatitis must be clearly analyzed because it simulates so many other upper abdominal entities. Acute cholecystitis, particularly the suppurative variety, requires careful consideration. This is especially true where impending perforation and localized peritonitis may be present. We are here aided by the presence of a palpable mass which attaches itself to the lower border of the liver. Pear-shaped, globular, this

mass denotes a distended gall-bladder due to cystic duct block. Irregularity or boggy-ness of this mass may be caused by an adherent omentum protecting an impending blow-out or a perforated gall-bladder. Because of its superficiality, light palpation, by placing the palm of the hand on the abdomen with the patient breathing slowly and deeply, makes for easy disclosure of the mass. If an exudate extends into the subhepatic region, the patient frequently will limit perceptibly the respiratory excursions, abdominal breathing is lacking. Thoracic breathing is the rule. In these cases slight cyanosis of the face is present and is often mistaken for the cyanosis of acute hæmorrhagic pancreatitis.

Perforation of a diseased infected gall-bladder into the free abdominal cavity, with resultant biliary peritonitis, produces shock which may well simulate the shock of acute pancreatitis, but no difficulty should be encountered in differentiating the two because of the preexisting gall-bladder story. Usually the patient had been confined to bed with an acutely distended cholecystitis, too frequently receiving so-called medical treatment in the hope that the cystic block, which may be due to stone or tumefaction, will subside and reestablish drainage.

Erroneous is the contention that gall-bladders rarely perforate, for too often have such catastrophes resulted from procrastination. If the sudden onset of acute pancreatitis be borne in mind, together with the absence of the local findings above enumerated, differential diagnosis will not be so difficult.

Acute intestinal obstruction deserves our next consideration, for differentiation from acute pancreatitis, especially that situated high in the intestinal tract, may offer some difficulty. Although the shock encountered in the sudden snaring of a loop of gut by a band or aperture may be great, the abdominal findings are easily differentiated from acute pancreatitis by visible peristalsis early in the disease, progressive vomiting, a painless abdomen, the absence of epigastric tenderness which radiates to the left transversely, the absence of left lumbar tenderness, and the absence of the malar flush of acute pancreatitis.

Acute renal colic, particularly on the left side, is at times attended by extreme pain and shock. If there be absence of radiation down to the groin, acute hæmorrhagic pancreatitis must be borne in mind. This acute renal colic may be due either to a stone or to pus. Pyuria aids greatly in the differentiation. A sudden torsion of a ptotic kidney with strangulation of the renal pedicle may well simulate acute pancreatitis. Here the history of ptosis in a patient who has lost considerable weight, with a history of Dietl's crisis, and a sudden physical exertion, may be the exciting cause. The kidney is readily palpated and is found enlarged and tender, if it be found in the lumbar region, or it may have been displaced to the mid-abdomen, but it will be found movable and may be repositied in the lumbar fossa.

Tenderness in the left inguinal region, a definite head zone is not at all

infrequent in acute hæmorrhagic pancreatitis, particularly if considerable hæmorrhagic fluid be present in the peritoneal cavity

Acute hematogenous infection or carbuncles of the kidney at times calls for differentiation. Here the antecedent history of some focal lesion, such as a furuncle, carbuncle, paronychia, or some upper respiratory infection, etc., with sudden onset in an otherwise healthy individual, of a chill, rise in temperature, tenderness in either lumbar region with lumbar spasticity with or without any urinary symptoms or findings, such as blood or pus, particularly if the anterior surface of the kidney be the site of adhesions to the parietal peritoneum, may be confused with acute hæmorrhagic pancreatitis. The toxæmia, the shock, the flush, paretic abdomen and the characteristic epigastric tenderness with radiation to the left of acute pancreatitis are absent.

Perforated gastric or duodenal ulcer with their antecedent ulcer history, then board-like rigidity, and scaphoid appearance of the abdomen, may well be distinguished from the paretic abdomen, the absence of resistance felt in the mid-epigastrium with radiation to the left. The early signs of spreading general peritonitis, the presence of gas in the peritoneal cavity, elicited by the absence of liver dullness, the absence of malar flush, the expiratory grunt, exclude the probability of acute hæmorrhagic pancreatitis. Then, again, the ulcer patient depicts a countenance characteristic of stomach pathology. The long thin, drawn dyspeptic portraying chronic pain is a facies easily recognizable.

Cardiac and coronary disease require consideration. Careful cardiac examination is absolutely essential before any operative intervention is instituted, for the protean manifestations of cardiac disease may simulate many intra-abdominal catastrophes. Preexisting cardiac history with tender liver due to right coronary closure, marked rigidity of the upper abdomen with extreme hypersensitiveness of the abdominal wall, frequently leads to correct diagnosis. Electrocardiograms are important adjuvants.

Perhaps too often do we err, but rather on the side of making the diagnosis of acute pancreatitis when such does not exist, but the knowledge that such an entity exists often leads to the correct diagnosis.

Complete exploration in many instances is interdicted because of the extreme gravity of the patient's condition, but knowledge of our findings in so far as feasible, are here added the better to understand the disease.

Fat necrosis, as mentioned above, has been taken as the criterion of diagnosis. This finding is, therefore, universal in our series.

Biliary disease was a concomitant finding in 84 per cent. Calculi were found in fifty-four cases of those presenting gall-bladder pathology. In two cases cholecystectomy had been previously performed. In thirteen no mention of gall-bladder exploration was made. Severe acute biliary disease was never encountered.

Pancreatic inflammation of varying degrees was found. Œdema and enlargement in forty-nine. Hæmorrhage, in addition to œdema and enlarge-

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ment, in twenty-three A congested gland was observed in seven cases, six fifty-two cases

The peritoneum presented the congestive variety of inflammation Fat necrosis was found throughout this structure The omental and pancreatic peritoneum were most frequently involved Beef broth fluid, that serosanguineous exudate resulting from peritoneal irritation, was present in were necrotic, and in three abscesses were present

Interesting is the observation that the omentum in acute pancreatitis assumes a peculiar grayish-yellow, and may feel gritty This finding, pointed out in 1915,² leads to the exploration of the pancreas, thereby disclosing pathology otherwise unsuspected This characteristic granular omentum was encountered in 43 per cent of our cases At times, this apron-like structure assumes such size as to allow of palpation before celiotomy

Operative Findings in Acute Pancreatitis

Observation	Incidence	Per cent
Fat necrosis	88	100
Gall-bladder disease	74	84
Biliary calculi	54	61
Beef broth fluid	52	59
Granular omentum	38	43

Pancreatic Findings

Œdema and enlargement	49
Œdema, enlargement and hæmorrhage	23
Œdema, enlargement and congestion	7
Necrosis	6
Abscess	3
Tail involved	2

The immediate treatment resolves itself into saving life Relieve the pressure on the semilunar ganglion and common duct by opening the pancreatic capsule If the patient's condition warrants, the operation of choice, cholecystectomy, removes the source of infection At times drainage of the gall-bladder must suffice to drain the pancreas

Operative Procedure

Procedure	Cases	Deaths	Mortality Per cent
Cholecystectomy with drainage	20	2	10
Cholecystostomy with drainage	40	7	17.5
Choledochostomy with drainage	2	0	0
Choledochostomy with cholecystectomy	3	0	0
Pancreatic drainage	23	14	60
General average	88	23	26

Twenty-three of our patients succumbed. Our rather high mortality rate of 26 per cent compares favorably with all others. We must recall, however, that operation is being performed in a very serious complication of disease which if treated early is more amenable to recovery. Proper early treatment of biliary disease will decrease the mortality rate of acute pancreatitis. The time to intervene is when the disease is still limited to the gall-bladder.

SUMMARY

- 1 The etiology of acute pancreatitis is discussed pro and con. Emphasis of gall-bladder disease as precursor cited.
- 2 Eighty-eight cases analyzed with especial reference to symptomatology.
- 3 Differential diagnosis stressed.
- 4 Operative findings recorded, operative procedures with results obtained.
- 5 Acute pancreatitis can be diagnosed pre-operatively if the existence of such an entity be borne in mind.
- 6 Early treatment of gall-bladder disease encouraged.

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REVIEW OF THE OPERATIONS DONE ON THE GALL-BLADDER AND DUCTS *

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NEARLY every operation which has been introduced has been subjected to a certain amount of abuse, which has usually taken the form of employing it in the absence of indications or even in the presence of contraindications. It would appear that time alone can determine the actual value of a surgical procedure. Many operations have failed to stand the test of time and have been relegated to oblivion, others have become fixtures although their fields of application may be far more limited than early enthusiasts thought possible. A glance over the history of surgery gives innumerable illustrations of these statements. One has but to recall the operation of ovariectomy and its world-wide abuse, that of removal of the coccyx to cure all manner of ills, those done for visceral ptoses, colectomy for constipation, not to mention its claimed benefits in thyroid disease, cystic disease of the breast and insanity, and the employment of gastro-enterostomy for the cure of epilepsy. These are only a few examples that come readily to mind, but they are sufficient to show that it is well to cast a philosophic eye over our work from time to time and not be carried away by enthusiasm for any one procedure.

The operations above mentioned have and probably always will have a definite place in surgery, but no surgeon today thinks of giving them the wide and wholesale application they once had. One reason for the foolish and unwarranted employment of operations has been the fact that he who questions a popular dogma or fad lays himself open to the criticism of being a conservative or behind the times, and most men of judgment have been content to stand aside and silent until time has done its work. The best illustration one could find of this truth is the history of resection of the colon.

The foregoing remarks are made as an apology for what is to follow in a consideration of the different operations done on the bile passages and in an attempt to estimate their relative values. The determination to discuss this subject is largely due to a prevalent idea among some surgeons and internists that the removal of the gall-bladder is a cure-all for all the diseases and infections of the biliary passages, and yet this is no more true than the claims made for some of the operations already mentioned, no more true than the belief that colectomy cures hyperthyroidism and insanity. The one point that needs constant reiteration and emphasis in surgery of the bile passages is not the particular type of operation, but to be sure of the condition of the common duct and liver, and that in the case of stones none are overlooked.

*Read before the Philadelphia Academy of Surgery, April 1, 1929.

Cholecystostomy was the first operation done for gall-stones and empyema, and although performed several times in the seventeenth century it was not generally practiced until the late eighties of the last century. Petit in 1743 did this operation for the first time with the deliberate purpose of removing stones. The previous operations were rare and most of them may be classed as accidental performances. Notwithstanding Petit's publication nothing much was done in gall-bladder surgery until the latter half of the last century and at this time, a number of American surgeons began to publish their operations.

Bobbs in 1867 performed the first cholecystostomy in one stage, previous to this adhesion of the gall-bladder to the abdominal wall was awaited or effected before the gall-bladder was opened. Ignorant of Bobbs's operation, a number of surgeons in different parts of the world in the next ten years performed cholecystostomy. Both Keen and Marion Sims, cognizant of Bobbs's publication, reported similar operations in 1877. In most of the early operations the manipulations were confined to the gall-bladder itself. In the early eighties, operations on the gall-bladder had become pretty well established, largely due to the work and publications of Langenbuch. Within the next ten years cholecystostomy was gradually recognized as the proper operation for gall-stones and infections of the gall-bladder.

In recent years so little has been said of it and so much of other operations that one might suppose that in the modern clinic it was no longer employed. Notwithstanding the development of other and better operations for most of the cases, this operation still has its place and its definite indications and is often a life-saving procedure when the other operations would carry with them too great a risk. Any surgeon of long experience can recall scores of patients very ill from empyema of the gall-bladder permanently cured by simple incision, removal of stones and drainage and who certainly would not have withstood the more formidable procedure. In such cases this operation is easily carried out with infiltration anæsthesia. If the stones are all removed it is remarkable how few of these patients have any further trouble. It is true that a very small percentage may have strictures with persistent mucous fistulas requiring subsequent cholecystectomy. The recurrence of stones is one of the arguments strongly put forward against this comparatively simple operation, but I should like to say that in my own experience the re-development of stones has been most unusual, and that if a stone is found at a second operation, it was probably overlooked at the first operation. I see recurrences after my operations for hernia and for duodenal and gastric ulcer, but recurrence of gall-stones is a rarity. I recall one case of definite recurrence of stones. The patient was a physician from whose gall-bladder, many years ago, I removed a number of stones. He came back in about a year suffering as before, and I was sure I had overlooked a stone, but at the second operation, I found not one but twenty-five light-colored stones all of the same size. This case stands out in my memory as a unique experience. All surgeons will agree that most stones found at a second operation represent "left overs" in the cystic or common duct and it would seem pertinent to observe in this

connection, that if stones are overlooked, the patient is better off with than without a gall-bladder

The experience and ability of the operator should always be taken into account when the choice of operation is being considered, and where these are lacking, cholecystostomy should be done, especially when the patient is a poor risk and access to the structures difficult. Nothing seems to me more absurd than the statement that cholecystostomy carries with it as high a mortality as cholecystectomy. Such an opinion is based on the statistics of large clinics and of experienced surgeons without regard to the fact that the extremely ill patients, and those who are bad risks are the ones usually subjected to cholecystostomy. In many of the cases of stones or sand in the common duct, especially if complicated by jaundice, I believe it is wise to preserve the gall-bladder, for it is these cases that are apt to have further trouble, and in such circumstances they are better off with a gall-bladder. In the aged also cholecystostomy is often better than cholecystectomy.

Cholecystectomy is not a new operation, having been first and successfully done by Langenbuch in 1882. It is today the most commonly performed operation for stones and infections of the biliary passages and may be looked upon as the ideal operation in most cases, but it is not in any sense a cure-all nor is it indicated in all cases. Before discussing this operation, when I will refer to certain objections to it, I should like to say that in my last three hundred operations on the gall-bladder and ducts, the gall-bladder has been removed in about 70 per cent. This will show that I give it a wide field of application.

First of all let us consider the physiological effect of the removal of the gall-bladder. It has been shown by experimentation on animals and confirmed by observations at later operations on patients, that an inevitable result of cholecystectomy is a dilatation of the common duct, of the hepatic ducts and of all their radicals. Whether this is particularly harmful I doubt, but it represents a disturbance of the whole biliary circulation. One is only justified in bringing about this anatomical change, with its physiological disturbance, by definite disease of the gall-bladder. This statement is made with the thought in mind that many normal gall-bladders are being removed and many others which only represent a participation in a general biliary infection, which is but little helped by cholecystectomy. Another aspect of this operation that needs consideration is the danger in its performance of injury to the common duct. The importance of avoidance of such injury has been repeatedly stated and yet the evidence of it is multiplying in every surgical clinic in the shape of strictures of the common duct following cholecystectomy "done elsewhere."

I would not say that all these strictures are the result of injury of the duct at the first operation, but I believe nearly all of them are. The harm is done by the careless use of forceps supposedly applied only to the cystic duct and to control bleeding from the cystic artery. The injury is not recognized until later when a persistently increasing jaundice is observed. In the last issue of *Surgery, Gynecology and Obstetrics* (March 27) Walters, of the Mayo

Clinic, reported seventeen cases of stricture of the common duct, in thirteen a cholecystectomy had been done "elsewhere" and in three a cholecystostomy had been done. Stricture of the common duct does undoubtedly occur from causes other than traumatism, but it is significant that the large majority follow cholecystectomy. Other reports and experience confirm the above figures.

Another statement which I am sure is incorrect and yet one hears it frequently, is that fewer and less crippling adhesions follow cholecystectomy than cholecystostomy. Has anyone ever seen any more dense and extensive adhesions than at a second operation after the removal of the gall-bladder? This is not put forward as an argument against cholecystectomy, but only an attempt to look facts in the face and oppose spurious contention. The adhesions after removal of the gall-bladder are said to be due to the introduction of a drain, and attempts have been made to do away with it. In many cases the drain is not necessary, but the difficulty is to know which they are. It is a common observation that in a small percentage of cases after cholecystectomy, leakage of bile occurs. If there is no loosening of the ligature on the cystic duct, this drainage probably comes from open radicals in the gall-bladder bed and no amount of careful suturing will always prevent it. Having lost one case from infection following bile leakage, I long ago abandoned closure without a soft rubber drain.

In a number of cases the removal of the gall-bladder becomes a very difficult procedure and its accomplishment may so add to the risk as to offset its advantages. In many of these cases where I have been most anxious to remove it I have resorted to subperitoneal excision, an operation well described by C. L. Gibson, and similar to the "rat-tail" operation sometimes employed in removing a very adherent appendix (*ANNALS OF SURGERY*, vol. lxxxiii, p. 613, 1926). I have already referred to the importance of removing all stones, but I cannot leave the operation of cholecystectomy without saying that it should never be done without absolute knowledge that the common duct is free of stones and obstruction. A dilated common duct in the presence of a functioning gall-bladder means obstruction and it should be opened.

In regard to the removal of stones from the common duct, I have but one thing to say, if one has a troublesome stone in the ampulla or in the duodenal portion of the duct, it is often better and more safely removed through an incision in the duodenum than by forceps passed into the duct. Much damage can be done to an inflamed or even to a normal duct by rough instrumentation, with great likelihood of subsequent stricture. The forcible passage of a probe or forceps through the duct to make sure of its patency is equally fraught with danger. Avoidance of traumatism to this delicate and essential passage should always be kept in mind in operations involving it.

Anastomoses of the gall-bladder or common duct with the stomach or duodenum, although not new operations, having been first successfully done in the early eighties, have been recently perfected and constitute well-recognized surgical procedures of value in cases of insurmountable obstruction of the common duct. For a time it seemed that these operations offered "a way

out" of many troublesome situations, and being so often successfully accomplished, their field of application was gradually enlarged, including even the treatment of duodenal and gastric ulcer. I confess that I had begun to feel that this method of internal drainage was the answer to many of our gall-bladder, common duct, and liver problems. In our zeal for improving and simplifying the technic we rather put aside any question of possible danger from an ascending infection. The operations became much easier by the use of catheters or small rubber tubing as a splint and as a means of insuring adequate drainage, although some surgeons insisted that a large stoma with direct approximation of the mucous membrane was the better procedure. The tolerance of the tubes had already been shown by Pierre Duval, who often passed them through the common duct into the duodenum and sutured them into position, and I think no subsequent experience has shown that the tubes cause any trouble *per se*, in spite of the fact that many of them have been shown in place by the X-rays years after the operation. Technically these operations would seem to offer all that could be desired, and yet I believe the future will show that their performance is only justified by an obstruction of the common duct which cannot be overcome.

If infection can ascend from the duodenum through the normal common duct then how much more easily can it take place with a permanently open communication? Experimentation on animals, X-ray studies and occasional clinical observations have, I think, clearly established the fact that these permanent artificial communications between the bile passages and the stomach or duodenum are apt to be followed by a more or less serious ascending infection. Beaver, of Rochester, Minn. (*Archives of Surgery*, vol. xviii, No. 3), found that after a series of cholecystogastrotomies on dogs, infection of the biliary passages and liver invariably occurred. The roentgenologists have also shown that at least in some of these cases barium will ascend into the biliary tracts. The clinical evidence of infection after these operations I am afraid we have too often attributed to a failure of the stoma to perform its function. Where a tube has been used and is still *in situ* such reasoning is certainly fallacious. Walters's cases present an interesting study in this connection. Although the large majority show an excellent result, in spite of the fact that many were distinctly bad risks, at least seven of the fourteen who survived the operation showed subsequent symptoms of infection which fortunately seem to have subsided in most of them. The most striking example is reported as follows: "In one case in which there was a very large anastomatic opening between the duct and the duodenum, severe cholangitis developed two or three months following the operation in the absence of extrahepatic biliary obstruction. It was accompanied by progressive enlargement of the liver and spleen and the formation of ascites. With the subsidence of the intrahepatic infection, jaundice and fever disappeared but the enlargement of the liver and spleen still persisted. The ascites, however, disappeared after the administration of a mercurial diuretic."

In February, 1925, I did a choledochoduodenostomy on a patient who had been operated upon "elsewhere" in January, 1924, the gall-bladder being removed for stones. At the first operation, troublesome bleeding from the cystic artery occurred which was controlled by forceps which were left in the wound. On removal of the forceps, drainage of bile began and kept up for some time. Six months later a gradually deepening and painless jaundice developed. When I saw the patient, a number of months later, his color was that of dark mahogany. When I exposed the common duct it was greatly distended and colorless, on opening it there escaped under great pressure a quantity of white bile. An anastomosis was made with a catheter, the large end in the duodenum. There was no stone in the ducts and the patient had never had any symptoms before or after his first operation of common-duct stone. The obstruction was due to cicatricial tissue. The jaundice gradually disappeared and the patient returned to his work. For the next three years this man had repeated attacks consisting of pain, chills, fever and jaundice all of short duration. As the tube did not show in the X-ray plates made three months after operation I thought perhaps the stoma had contracted. As his attacks became of shorter duration and the intervals between them longer, such a theory was hardly tenable. The patient is now apparently quite well.

It seems likely that infection alone can explain this post-operative course. This evidence is not presented with the idea of disparaging anastomosis between the bile passages and the gastro-intestinal tract, but to show that operations should only be done where there is an irremovable obstruction to the normal channel. In concluding this discursive and critical review I would offer the following propositions:

- 1 Cholecystostomy still has a distinct field in gall-bladder surgery
- 2 Cholecystectomy approaches the ideal operation, but is not applicable to all cases. The only warrant for this operation is definite pathology. The normal gall-bladder should not be removed.
- 3 The anastomoses are only justifiable in the presence of an irremovable obstruction of the common duct.
- 4 More important than the choice of operation is the removal of all stones and the assurance that the common duct is patulous.
- 5 Drainage is still essential in these operations.

SURGICAL CONDITIONS OF THE BILIARY TRACT⁺

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IN ANY discussion of the gall-bladder and bile ducts, it is of interest to inquire as to what are the functions of the structures concerning which we are to talk. This question can readily be answered as far as the common and hepatic ducts go, serving as they do as the canal along which bile is conveyed to the duodenum, equipped as the canal is with a sphincter of Oddi and also with the duct obliquely entering through the duodenal wall, so that a competent valve is formed. We know that bile descends along the ducts by secretory pressure, that the ducts are not equipped with sufficient musculature for any marked contraction, and that even though the gall-bladder be removed, although the common and hepatic ducts dilate, still bile is satisfactorily delivered into the duodenum, and duodenal contents do not ascend the ducts to produce infection in the liver.

When we come to discuss the function of the gall-bladder, however, things are not as plain. We know that the gall-bladder is equipped with muscle fibres, we know that the gall-bladder does contract, particularly with a fat meal, and yet is never found empty, we know that this contraction can be brought about by a hormone as proven by the crossed circulation experiments of Ivy and Oldberg, of Northeastern University. What the purpose of this organ is, however, without which humans and animals survive so well, is by no means clear. Various theories have been advanced as to the function of the gall-bladder, such as concentration of bile, and there seems no question but that this is its most important function, such as equalization of biliary pressure and even bile storage, but it must be admitted that whatever the function of this small sac is, it does not appear to be one which plays any essentially important part in the body. Until physiologists can advance our knowledge of the purpose of this structure, we must admit its similarity to the vermiform appendix, except for the vestigial origin of the former, and accept the fact that like the appendix it does not appear to serve any indispensable purpose, but frequently does serve many undesirable ones.

If one be permitted to throw out those uncommon cases of carcinoma of the gall-bladder and traumatic rupture of the gall-bladder, then we can limit for practical purposes the causes of the pathological states of the gall-bladder with which we have to deal to those of infection and those of calculi, both of which conditions, while often separate in the beginning, almost always eventually become coincidentally present.

* The Stewart Memorial Address, read before the Pittsburgh Academy of Medicine, November 30, 1928.

We are not with certainty aware as to just how infection reaches the gall-bladder. We cannot with certainty say that the infection spreads from the liver to the gall-bladder, as has been stated by Graham, in the form of a hepatitis, although today this is the most tenable theory, or whether it reaches the gall-bladder by ascension, or by the blood stream. For the present, we can only note the frequency with which infection occurs in the gall-bladder, the destructive effects of infection upon the gall-bladder both as to its ability to contract and upon its ability to concentrate bile. We cannot fail, also, to be impressed with the frequency with which gall-stones are associated

with infection in the gall-bladder, and with the probability that this infection plays a very considerable part in the production of gall-stones.

That gall-stones exist not infrequently without infection we all know, as has been stressed by Aschoff in his discussion of the cholesterol gall-stone. Everyone who is dealing with gall-bladders surgically has repeatedly observed those pure cholesterol stones of canary yellow or pale whitish color with crystalline centres in gall-bladders which show no evidences of infection.



FIGS. 2C and 2D.—Microphotographs showing single cholesterol laden polyp-like projections of gall bladder mucosa. The cholesterol stains black. These are microphotographs of one of the white specks in the so-called strawberry gall bladder.

(Fig. 1) It seems probable, therefore, from the frequent occurrence of cholesterol gall-stones and the cholesterol gall-bladder that some change or error in the cholesterol metabolism plays a very considerable part in the production of gall-stones.

As the result of our own practical experience with biliary tract diseases, it is at least possible to construct in our minds a very reasonable sequence of conditions in the development of gall-stones, each one of these conditions representing states of the gall-bladder which we have seen in various individuals at the time of operation. We know, for instance, from an experimental point of view, that Dewey has been able to produce gall-stones in rabbits by feeding cholesterol until a hypercholesterolemia was produced. We know also that there is an increase in the blood cholesterol in pregnancy and in diabetes both conditions with which we have clinically associated a

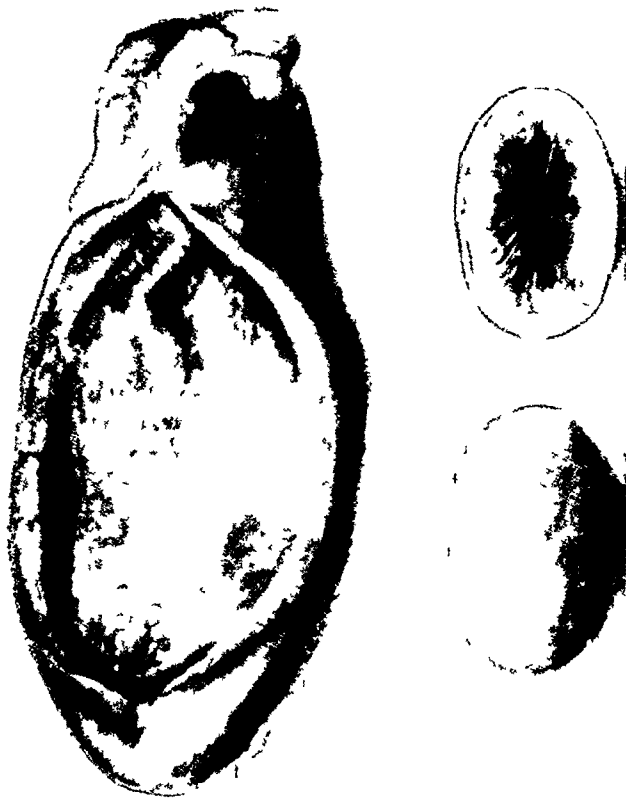


FIG 1—The single, canary yellow, pure cholesterol stone and a cholesterol gall bladder



FIG 2A—The early cholesterol (strawberry) gall bladder. The fine white specks represent cholesterol deposits in the mucosal projections lining the gall bladder and are shown in the microphotographs Figs 2C and 2D



FIG 2B—The cholesterol gall bladder which has progressed to the stage of multiple small cholesterol stones. Note the white cholesterol plaques still in the mucosa lining the gall bladder



FIG 3A—The early calcium bilirubin stone. Note the absence of cholesterol and the thick walled gall bladder



FIG 3B—Late calcium bilirubin stones. Note the thick walled gall bladder, the absence of cholesterol deposit on the pale smooth mucosa, the result of long standing infection

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definite gall-stone incidence—in the former much more than in the latter. We further know that there is a hypercholesterolemia in jaundice. We all associate gall-stone incidence with adiposity, and we are all aware of the increase in blood cholesterol with weight reduction procedures.

A careful inspection of gall-bladders removed at operation with the question of the development of cholesterol stones in mind permits one to observe such evidences of various cholesterol changes in the gall-bladder wall and within the gall-bladder itself that it is possible to construct a mental picture of the development, at least, of a cholesterol gall-stone, from the point of deposit of cholesterol crystals beneath the lining mucosa of the gall-bladder up to the point of the development of fine grains of cholesterol in the form of sand (Fig 2A) and from these to the development of considerable sized multiple or single cholesterol stones (Fig 2B), examples of which will be shown on the screen.

We now know from the work of Boyd that the so-called strawberry gall-bladder, which upon removal is found to show numerous small white specks upon its mucous-lined wall, similar to the

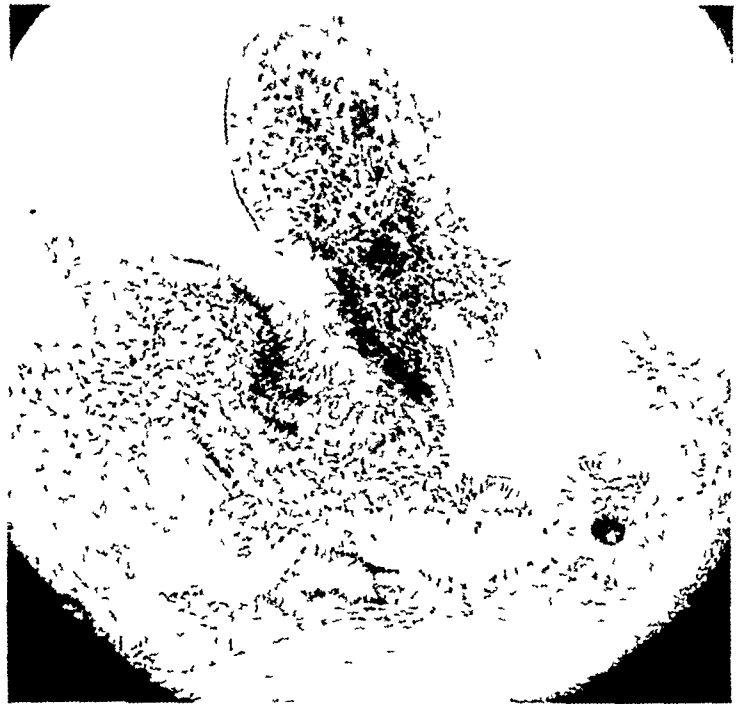


FIG 2D

small white dots upon the covering of a strawberry, is the true early cholesterol gall-bladder, and that the white specks are lipid deposits of cholesterol beneath the polypoid mucosa of the gall-bladder. We know also of the tendency of these cholesterol-laden polypoid masses to break off at their base (Figs 2A–D), and one does not have to stretch the imagination unduly to assume that such crystal-laden masses may well serve as the nuclei of stones when floating free in bile rich in cholesterol crystals.

While pure cholesterol stones occur without associated infection, it is probably true that infection frequently soon appears as the result of the presence of these foreign bodies, particularly if one of the stones becomes lodged in the cystic duct and produces stasis as the result of an obstruction to the outflow of bile.

That infection of the gall-bladder is common is proven by the fact that Mentzer at The Mayo Clinic found in six hundred and twelve autopsies, that the gall-bladder showed cholecystitis in 66 per cent of the cases. As has already been stated, the association of gall-stones and infection is con-

sistently striking, and while the early stones unassociated with infection are no doubt due to some error in cholesterol metabolism, those stones of calcium bilirubin origin are in all probability the result of, and always associated with infection of the gall-bladder (Figs 3A-B). A further discussion of the arguments as to how infection reaches the gall-bladder and as to whether or not bile both enters and leaves the gall-bladder by the cystic duct (Sweet believing that bile enters but does not leave the gall-bladder by



FIG 4—Showing an incomplete stricture of the hepatic duct, probably due to indiscriminate clamping in cystic artery bleeding. Note the two methods we have employed for identifying the main bile duct, one by demonstrating the division of the hepatic duct and two, by increasing the parietal peritoneum beside the duodenum rotating that inward and demonstrating the retroduodenal duct. The common duct is open for retrograde probing to demonstrate the stricture. The insert, 1-4 shows the method of suturing the longitudinally incised stricture about a T tube.

the cystic duct), as to the mechanics of how the gall-bladder empties itself, as to the presence and function of the sphincter of Oddi, as to what causes bile to enter the duodenum by spurts, and as to the ability of the gall-bladder to concentrate and store bile, would convert this lecture into an academic one rather than a clinical one, as is my purpose, dealing with our clinical experiences with biliary tract disease.

For practical purposes we may assume that the above-stated points have been fairly well proven, as follows. Bile does enter and leave the gall-bladder by the cystic duct. The gall-bladder probably empties itself by the sum total

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of several factors its elastic recoil, its muscular walls, abdominal pressure, and relaxation of the sphincter of Oddi. There is little question now of the ability of the gall-bladder to concentrate bile, and the spurts of bile into the intestinal canal are in all probability due to the change in tonus and intraduodenal pressure within the lumen of the intestine.

Let us now consider the practical aspects particularly of gall-bladder disease. First, cholecystitis. Clinically, we are today considerably handicapped in dealing with cholecystitis, due to the fact that while we have made marked advances in the chemical and roentgenological studies of the diseases of the gall-bladder, the reports from the pathologist's laboratory regarding this condition still fall far short of the clinician's desire. There is no lack of agreement either clinically or pathologically as to the diagnosis of acute cholecystitis, and there is no reason for me to discuss the subject of acute cholecystitis.

Chronic cholecystitis, however, is a very much different problem. By chronic cholecystitis we mean to indicate a non-acute lesion of a gall-bladder not containing stone and supposedly producing symptoms. This

we feel strongly is today one of the most difficult and unsatisfactory of all the lesions of the gall-bladder with which to deal. It is difficult, first, because of the fact, as already suggested, that our pathologists, at any rate, almost never return us a pathological report of a normal gall-bladder, and no matter how normal the gall-bladder may appear, it seems to contain sufficient round-cell infiltration and other evidence so that the pathologist is usually led to report his findings as consistent with chronic cholecystitis.

The condition is further made difficult by the fact that chronic cholecystitis is not typified by any classical and definitely tangible chain of symptoms. It is additionally complicated in that a great many patients who are

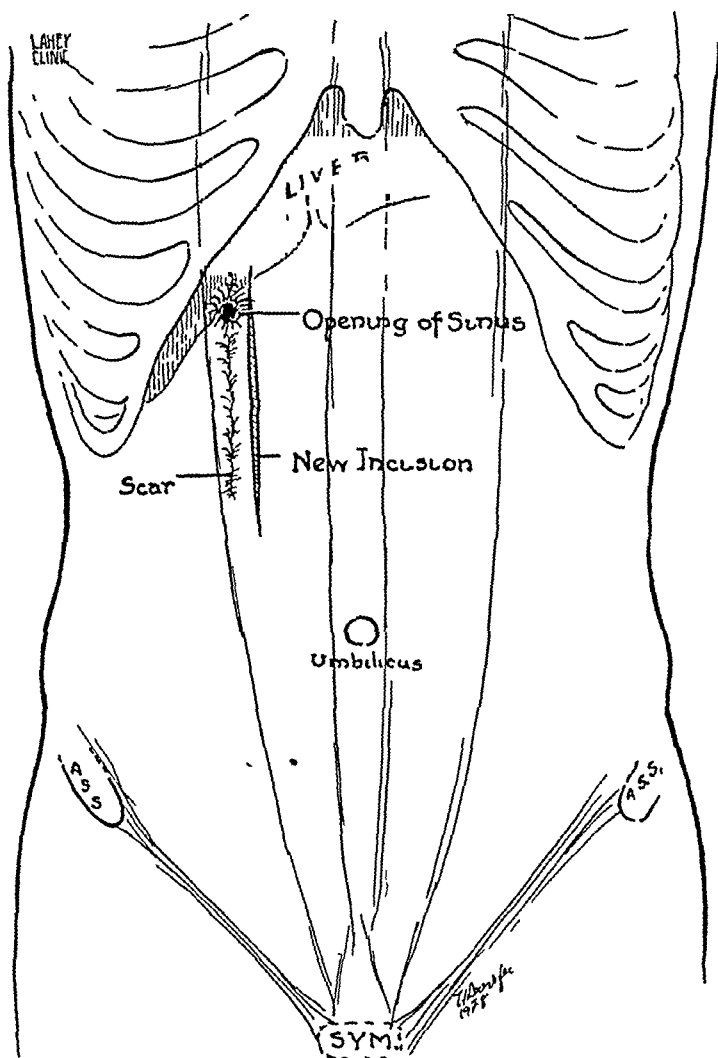


FIG. 5.—The permanent biliary fistula is shown in the upper end of the old scar and the new incision for coning and implanting of the fistula is shown just inside the previous one.

operated upon for supposed chronic cholecystitis, and whose gall-bladders have been reported by the pathologists as chronic cholecystitis, still continue to suffer from the same chain of symptoms from which they suffered previous to the operation. Indeed, so uncertain are we today regarding the clinical and pathological diagnosis of many cases of chronic cholecystitis that we are almost entirely dependent for certainty of diagnosis upon the patient's interpretation, following surgery, as to relief or non-relief of her

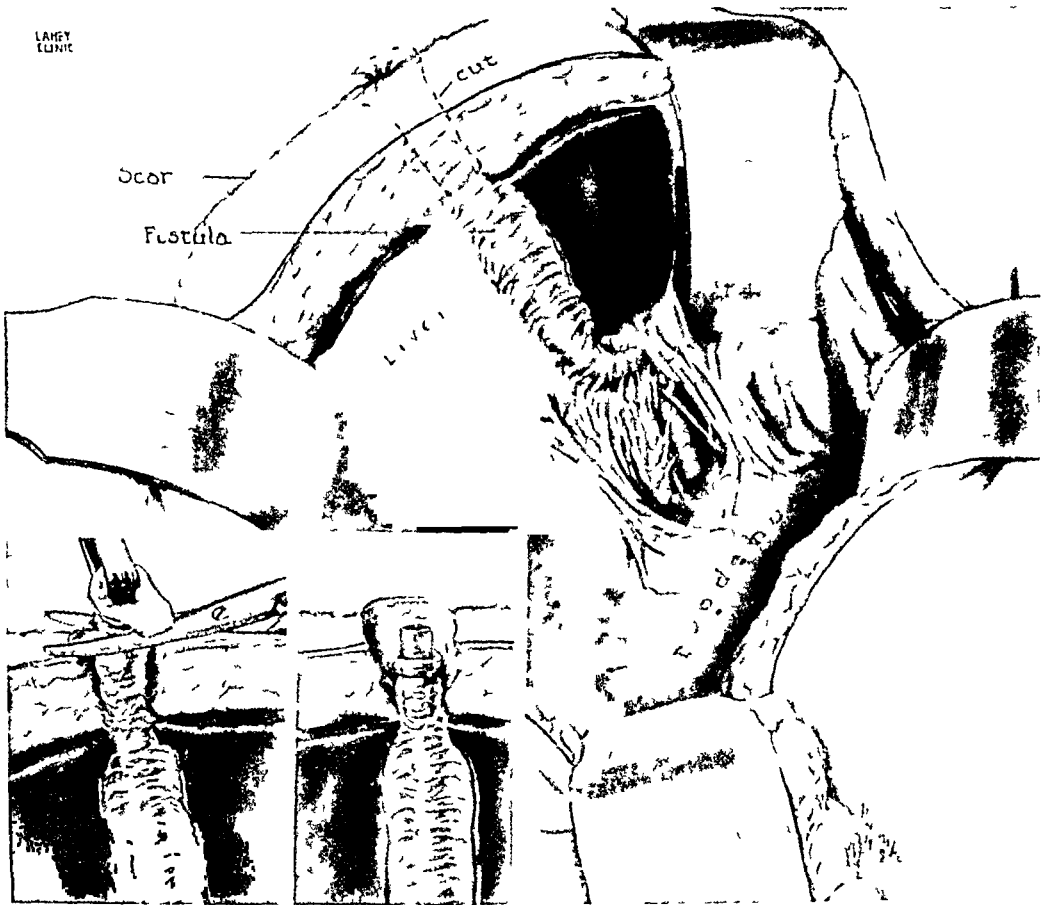


FIG 6—The fistulous tract is shown adherent to the bed of the liver. The insert shows the fistulous tract cored out of the abdominal wall, its button of fistulous skin cut away and a short segment of rubber catheter tied into the end of the fistulous canal. Note that the fistula is freed only down to the border of the liver. This point is stressed since the success of the procedure depends upon leaving the fistula adherent throughout its length to the liver bed. This insures good vascularization for the fistulous tract and but a short unvascularized segment, which is to be inserted into the jejunum, duodenum, or stomach.

symptoms. The more vague the symptoms from which the patient is supposedly relieved following cholecystectomy, the less valuable this criterion becomes.

In this condition of so-called chronic cholecystitis, it becomes not only necessary to employ every diagnostic measure in attempting to determine definitely the presence of this lesion, but it is necessary to eliminate insofar as is feasible the possibility of other factors entering into the production of symptoms suggesting the possibility of this lesion. The very vagueness of the symptoms of chronic cholecystitis of necessity often makes the diag-

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nosis doubtful Unless there is definite evidence of gall-bladder pathology by cholecystogram, such as failure to fill or distortion of outline, together

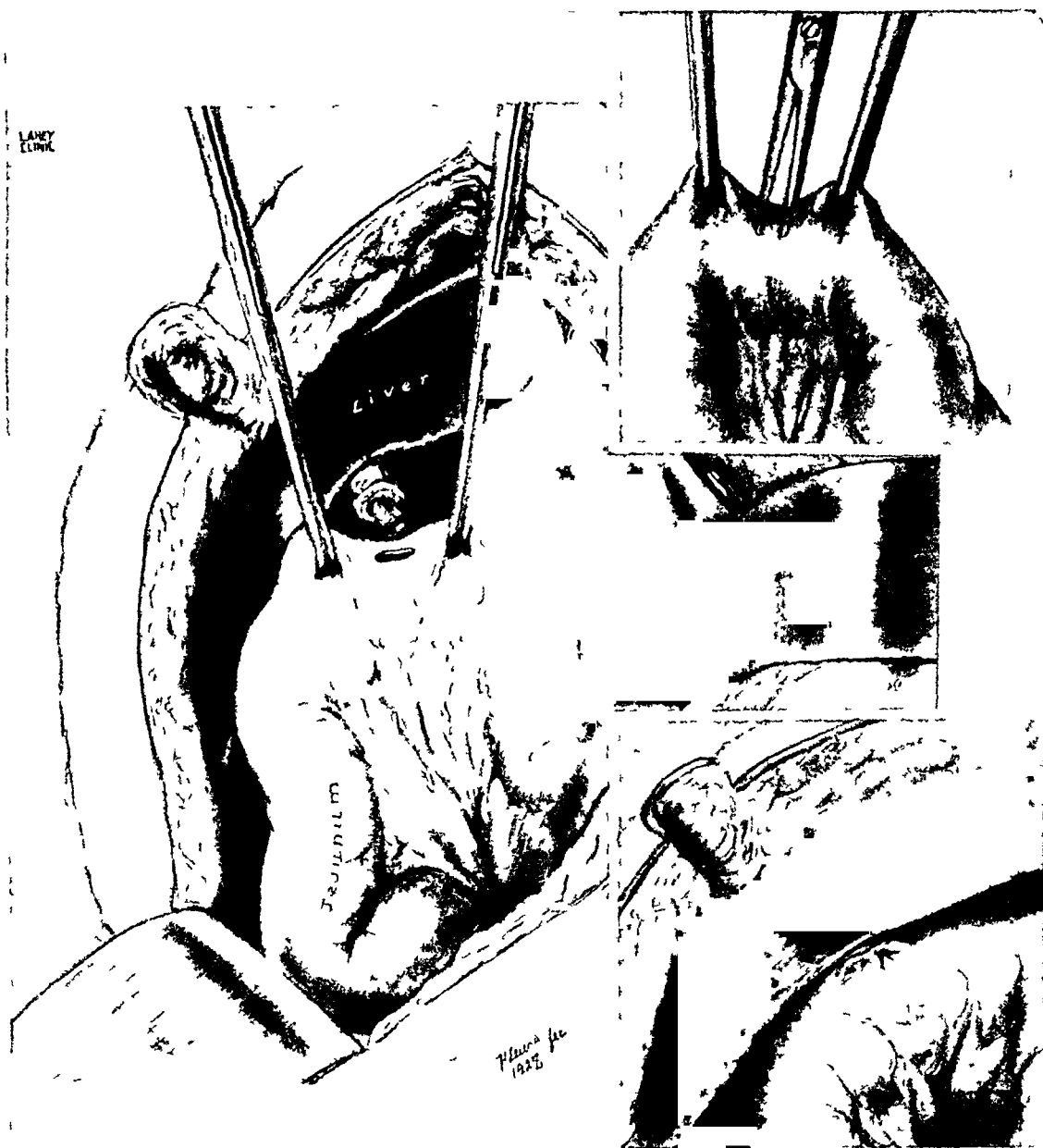


FIG 7—The fistulous tract prepared as described in Fig 4 The anterior surface of the liver freed of any of its adhesions to the abdominal wall and parietal peritoneum This permits the liver with its prepared fistulous tract to fall downward so that a segment of jejunum may be found which can easily be brought up to it This segment is opened as shown in the upper right insert, by forcing a sharp pointed hemostat into the bowel grasped by two backing forceps Such a procedure has the advantage of making but a small opening which can be dilated by gently spreading the jaws of the hemostats thus avoiding cutting of muscle fibres pouting of mucosa and permitting a very accurate fit to be made between the opening and the fistula The lower right insert shows a purse string suture in the jejunum about the implanted fistula It does not show a stitch between liver capsule and the jejunum to hold the latter in close contact with the liver Note that the purpose of the short segment of rubber tube to be passed later into the jejunum is to temporarily prevent the purse string suture from occluding the implanted fistulous tract

with clinical evidence of the disease, the wisdom of surgical intervention is doubtful

Cholecystography has proven to be one of the greatest factors in advancing the diagnosis of gall-bladder lesions, but, as in other laboratory measures, is of value only when correlated with clinical findings

We have felt justified in making a diagnosis of chronic cholecystitis and advising cholecystectomy in our clinic when the case could be said to meet the following requirements. In the presence of symptoms such as nausea, gaseous eructations, abdominal distention, and right upper abdominal pain when adequate investigation failed to demonstrate other lesions which might be the cause of the symptoms, when the symptoms persisted in spite of medical measures, and when suspicious X-ray evidence by cholecystography was present. Under such conditions cholecystectomy has yielded satisfactory results. Cases operated without complying with these criteria will, we believe, yield a high percentage of unsatisfactory results.

There is one other condition in connection with chronic cholecystitis about which I wish to speak. That is, not removing a gall-bladder because of its normal external appearance, in a patient operated with the diagnosis of chronic cholecystitis based upon the criteria as already stated. We have assumed the position that no matter how normal the gall-bladder may appear at operation, if the patient's symptoms have been sufficiently distressing to make surgery worth considering, if they cannot be explained by other conditions after adequate investigation, if they are not relieved by medical measures, and if there is suspicious X-ray evidence by cholecystography, then, as already stated, no matter how normal appearing the gall-bladder may be, it should be removed. If under these conditions, because of the normal appearing gall-bladder, cholecystectomy is not done and then the symptoms persist, how may we say that the remaining gall-bladder is still not the cause of the symptoms? This advice is necessarily premised upon the conscientious adherence to the criteria as stated, and unless the fundamental factor, the presence of fair operative indications, is adhered to, the doctrine not only becomes valueless but dangerous. We must admit, I think, that the lack of gross pathological evidence with the gall-bladder in place, in chronic cholecystitis, fails to outweigh fair and critical clinical and laboratory findings.

The most interesting, the most tangible, and the most satisfactory of all of the biliary tract lesions is that of gall-stones. There are two preliminary statements concerning this condition which I would like to make. First, there are no harmless gall-stones, and second, an attempt should be made to diagnose and operate gall-stone patients earlier. While biliary colic may be the first symptom which causes the patient to present himself for advice, and may be the first impressive evidence to the patient that all is not well in his upper abdomen, nevertheless in many instances there have been abdominal and digestive symptoms occurring previous to the biliary colic, the investigation of which would often lead to the earlier diagnosis and removal of the gall-stones. We would urge also against permitting patients in whom there is no contraindication to surgery to go through repeated attacks of gall-stone colic before coming to surgery.

The sequelæ of long-standing gall-stones are numerous and undesirable. We know that long-standing gall-stones are quite constantly associated with long-standing gall-bladder infection. We know that the longer gall-stones

exist and the greater the number of attacks, the greater the incidence of common duct stones with their added operative risk. While we cannot say that it has been conclusively demonstrated that the lymphatics of the gall-bladder drain into the pancreas and so produce a pancreatitis of lymphogenic origin nevertheless there are certain features in association between the pancreas and cholelithiasis that indicate that the latter has no good effect upon the former. While we cannot say that the hardened head of the pancreas which is so frequently seen with gall-stones is a pancreatitis as the result of the gall-bladder infection, and that a pancreatitis associated with gall-bladder disease causes diabetes (fortunately most of the islands of Langerhans are on the tail of the pancreas), nevertheless we can say that a patient who has diabetes and gall-stones can be made better by removal of his gall-stones and gall-bladder. In fact, Dr. E. P. Joslin has stated that if he could select his type of diabetes to have, he would choose a diabetes associated with gall-stones, since it would be capable of the greatest improvement through the removal of the gall-stones. We cannot also disassociate the frequency with which gall-stones are found in patients operated upon for acute pancreatitis.

So possible is it now, by means of cholecystography, for which we owe so much to Evarts Graham, to visualize early gall-stones by contrast shadows, and to demonstrate pathological gall-bladders, that we feel strongly that all vague, unexplained right upper abdominal complaints should be investigated for the possibility of early gall-stones. Patients who have had frank attacks of gall-bladder disease should be told of the disadvantages of delay in this condition and urged to early surgery, when the gall-bladder can be removed accurately, and when its bed can be so covered that there are few remaining adhesions between the duodenum, pylorus and gall-bladder bed interfering with the function of those structures.

The diagnosis of gall-stones at the stage of typical gall-stone colic requires no discussion. The less typical evidences of the condition are, however, not so easy to interpret. It has been our experience that the type of discomfort caused by gall-stones may vary from simple fulness after meals up to the typical colic of such severity as to demand morphia. The reference of pain in a typical way to the right shoulder-blade is by no means constant. We have seen pain referred in all directions and occasionally have observed the maximum pain to be localized in the left epigastrium.

In our experience, the point which we have found to be most suggestive of cholelithiasis in the patient's history is so-called residual tenderness over the gall-bladder region after the attack has passed, due, probably, to the abating infection in the gall-bladder wall.

When jaundice appears with typical gall-stone colic, it is strongly suggestive of the presence of stones, and of course strongly suggests the presence of stones within the hepatic or common duct. When jaundice is again and again associated with repeated gall-stone colic, one may be quite sure of the presence of hepatic or common-duct stones.

The fact, however, that jaundice does not occur in association with gall-

stone colic by no means indicates that common-duct stones are not present. We have in our clinic up to now operated upon 908 patients for biliary tract disease, and of these, 179 operations were on the common or hepatic ducts, either in addition to the gall-bladder operation or on the bile ducts alone—an incidence of main bile duct difficulties (demanding exploration in this series) of 20 per cent, one in five.

As the result of our experience with surgery of the bile tract, we have had the following conclusions impressed upon us: (1) That common-duct stones frequently exist in the absence of any symptoms, (2) that gall-bladder colic may occur with jaundice and symptoms strongly suggesting the presence of common-duct stone and yet none be found, (3) that infection in the common and hepatic ducts may occur unassociated with gall-stones and may produce symptoms and signs similar to those of common and hepatic-duct stones.

Up to January 1, 1926, there were done in the clinic 619 operations upon the biliary tract, of which ninety-six were explorations of the common or hepatic ducts, a percentage of 15.5 per cent choledochostomies. From 1926 to 1927, 198 biliary tract operations were done, of which fifty were or included explorations of the common or hepatic ducts, a percentage of 30.3 per cent choledochostomies. Up to the year 1926, our 15.5 per cent explorations of the common or hepatic ducts yielded a discovery of duct stones in 8.4 per cent of the cases. Between 1926 and 1927 our 30.3 per cent explorations of the common and hepatic ducts yielded a discovery of common or hepatic-duct stones of 12.6 per cent. In other words, since 1926 we have doubled the per cent of cases in which we have explored the ducts with the result that we have increased the per cent of common or hepatic duct stones discovered by 50 per cent, and during this time our mortality has diminished rather than increased, up to 1926, 5 per cent, from then on, 1 per cent.

We feel sure from our experience that we have in the past overlooked many common or hepatic-duct stones, and that we must guard against a tendency to be satisfied solely with the removal of the gall-bladder and its contained stones in many cases of gall-stone colic.

Since we have a great many times removed common-duct stones from patients having no symptoms suggesting their presence, we feel sure, from our experience, that no matter how lacking the case may be in the way of symptoms or visual evidence, such as a thickened gall-bladder or dilated common ducts, of the presence of stones in the main bile channels, a most painstaking search and, if necessary, exploration of the ducts must be carried out as to their possible existence. This does not mean that the common duct must be opened in every case. It does mean that most careful visualization of the ducts must be made to demonstrate their size and thickness, that most careful palpation of the lower end of the duct must be carried out, since it is at this point where the duct is so often surrounded by the head of the pancreas that stones are so easily overlooked. In this connection, we have often been aided by incising the parietal peritoneum beside the duodenum.

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and rotating that structure inward so that the considerable portion of the common duct which is behind the duodenum is exposed, making easier, thus, the approach to the lower end of the common duct

In our experience with biliary tract surgery, we have had occasion to deal with eleven strictures of the hepatic or common duct. Strictures of the common duct, other than the complete absence of the ducts or part of the ducts occurring in the new-born, occur at three points: in the hepatic duct just above where the cystic duct enters the common, in the main duct at the part where the cystic duct joins the common duct, and at the point where the common duct enters the duodenum.

A majority of the cases of stricture of the main bile ducts with which we have had to deal has followed previous gall-bladder operations, and investigation of the description of the previous operations in most of the cases has brought out the fact that a technical difficulty arose during the operation, consisting of hæmorrhage from the cystic artery and difficulty in controlling it, or difficulty in clamping the cystic duct.

Of these eleven cases, one was a stricture of the common duct at its point of entrance into the duodenum, four have been of the common duct at the point where the cystic duct enters the common duct, three were in the hepatic duct at the point where the cystic artery is in relation with it, two were cases in which the common and part of the hepatic duct were completely destroyed, and in one there was complete obliteration of the main bile channel from the duodenum well up into the substance of the liver. Two of the strictures followed operations done in the clinic and nine followed operations done elsewhere.

The diagnosis of injury or severance of the common or hepatic ducts is not difficult when following an operative procedure on the gall-bladder or ducts in a patient whose bile has previous to operation entered the intestine, there is an immediate and persistent discharge of bile through the wound, with persistently clay-colored stools, and in a patient in whom there is no question of carcinoma.

The diagnosis of stricture of the common duct due to an injury and incomplete narrowing of the ducts is not as simple as when the duct is completely severed and there is a complete and persistent discharge of bile through the abdominal wall. Strictures of the ducts are for the most part the result of a clamp or a tie being placed upon the wall of the duct, causing injury to the wall of the duct and later contraction of the scar (Figs 3 and 4). In our stricture cases jaundice did not develop for several months following the previous operation, and when it did appear was not associated with any severe degree of pain. One should, therefore, be suspicious of the presence of a stricture of the common or hepatic duct when relatively painless jaundice appears a few months after a gall-bladder operation, particularly if the operation has been associated with technical difficulties during its performance. Repeated attacks of painless jaundice with the above history quite definitely suggest the possibility of the common or hepatic duct.

We have been much interested in operating upon these strictures of the common and hepatic ducts to observe to what degree the ducts could be narrowed and yet exist so for months without jaundice. In many instances the opening through the strictured duct was so small that it would hardly admit the point of the smallest probe yet jaundice in these cases doubtless had not occurred until infection, swelling, and the accumulation of mucus had brought about a blocking of the already narrowed duct. It is evident, then, that sufficient bile can pass through ducts which have been very much narrowed without causing back pressure enough to produce jaundice, provided there is no infection present.

There is a variety of methods of repairing strictured ducts, but most of them are far from satisfactory in that the stricture tends to recur with subsequent attacks of jaundice when infection is again superimposed.

We have repaired all of our strictured ducts of this type by the method illustrated in inserts 1-4 (Figs 3 and 4), consisting of suture of the duct about a short T-tube after longitudinally increasing the duct at the point of stricture.

The two cases of complete permanent external biliary fistula which we have repaired were cured by a method which we published in *The Surgical Clinic of North America*, Lahey Clinic number, 1924. It had previously been done successfully, but not reported, on a patient without our knowledge also by Dr. Hugh Williams, of the Massachusetts General Hospital, Boston. It consists of carefully preserving the fistulous tract down to the liver and implanting it into the stomach or duodenum. In one patient we transplanted the fistulous tract into the duodenum successfully six years ago, and in the other into the stomach five years ago. Both patients are today alive and well without jaundice and with bile-colored stools, one after having discharged all of her bile through an abdominal biliary fistula for twenty months, and the other after having discharged all his bile through an abdominal fistula for three months.

The principle upon which I first undertook the operation was that if an external biliary fistula would remain open—and we know that it will—it must do so only because the secretory pressure of bile is greater than is the ingrowth or contractility of the scar tissue in the wall of the fistula. I therefore assumed that if an external biliary fistula would remain open, then if I could convert it into an internal one it would likewise remain open, which has proved to be so in these two cases and in cases since reported by other operators. The method will be illustrated and described with the slides (Figs 5 to 7).

One of the most difficult decisions to make in dealing with biliary tract disease is whether or not to advise surgery in a patient who is jaundiced but who has not had the pain which is characteristically associated with jaundice due to cholelithiasis. We all know how undesirable it is to operate upon patients whose jaundice is of infectious origin, and how particularly undesirable it is to administer a general anæsthetic to a patient with jaundice of

infectious origin because of the lowered resistance of the infected liver to a toxic agent. Likewise, we are all anxious not to submit the patient with painless and progressive jaundice, which is due to malignancy, to the additional suffering and burden of an abdominal operation unless we can offer him some possibility of real relief, even though it be of but short duration. In this connection we have found Courvoisier's law of real service. Courvoisier's law is that in the presence of jaundice a dilated gall-bladder is indicative that the obstruction to the bile flow is due to malignancy, while a contracted gall-bladder indicates that the obstruction is due to stone. I have several times talked of the value of this law. It is at once evident, however, that only the portion of the law which has to do with the dilated gall-bladder is of value, since the dilated gall-bladder may be felt through the abdominal wall, while the contracted gall-bladder may be demonstrated only at autopsy or operation, and is therefore of little value in arriving at a pre-operative diagnosis or as an aid in determining the plan of treatment to undertake.

After considerable experience with cases of painless jaundice of the type spoken of, we have modified the law for our purposes as follows, and have found it with these modifications to be of greater service. In a patient with painless and progressive jaundice, with persistently clay-colored stools and with a dilated gall-bladder, the obstruction is quite certainly due to malignancy either of the head of the pancreas or of that portion of the common duct below the part where the cystic duct enters it. In such a case operation may be justifiably urged, since a cholecystenterostomy, the anastomosis of the gall-bladder to the stomach, duodenum or jejunum may be done with assurance of relieving the jaundice, thus ridding the patient of the intolerable itching and the undesirable hebetude which is so frequently associated with jaundice.

When, however, the above-stated features are not all present, that is, when painless and progressive jaundice together with persistently clay-colored stools, but without dilation of the gall-bladder, are present, then almost never will surgery be advisable, since, if the condition is due to infectious jaundice, surgery is not wise, and if it is due to malignancy, the obstruction must have extended above the junction of the cystic duct and common duct, or the gall-bladder is so destroyed by fibrosis that it will not dilate, either of which conditions will prevent sidetracking the flow of bile up the cystic duct through the gall-bladder and into the bowel. The only exception to the last statement in painless and progressive jaundice will be the occasional rare case of silent common-duct stone. In our experience, however, silent common-duct stones may be differentiated from biliary obstruction due to malignancy by a careful watch and record of the stools for bile, since in painless jaundice due to malignancy the obstruction is, as a rule, progressive and complete, so that the stools are usually consistently and persistently uncolored, while in biliary obstruction due to stone there are repeated periods in which bile can be found in the stools. This latter simple point in the differentia-

tion of silent common-duct stone from malignancy is of great value, and often not made use of

CONCLUSIONS

The diagnosis of non-calculous chronic cholecystitis is difficult and uncertain. Removal of the gall-bladder may be justifiably advised when adequate investigation has failed to reveal conditions other than cholecystitis as the cause of the symptoms, when medical measures have failed to relieve the condition, when cholecystography shows evidences of an abnormal gall-bladder, and when the symptoms are of sufficient magnitude to make surgery worth considering.

There are no harmless gall-stones. The diagnosis of gall-stones should be made as early in the disease as possible and operation undertaken as early as possible to avoid the undesirable results of long-standing cholelithiasis.

Strictures of the main bile ducts most commonly follow operative injuries and can for the most part be repaired by a plastic operation on the duct.

Courvoisier's law as modified here has been very helpful in deciding for or against operation in cases of painless and persisting jaundice.

MORTALITY OF ENTEROSTOMY IN ACUTE ILEUS*

IMPROVEMENT NOT REFERABLE TO THE TIME ELEMENT

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IN AN earlier article by the writer, attention was called to the importance of the time element in cases of acute ileus¹. In another paper² an attempt was made to show that this time element must be taken into account if one desired to make a fair comparison of results between two series of acute ileus cases, because of all factors contributing to the excellence of results in this condition early operation is apparently the most important (See Tables III and IV).

The greatest loss of time usually occurs before rather than after the patient has been seen by a surgeon and this is unavoidable at present. Not until the public and the profession in general have been made to understand (at least as clearly as they do now in regard to acute appendicitis) that time is of the essence and that delay means added danger will the mortality curve in acute ileus fall to a point where one can look at it without a shudder. Surgeons have been saying this since the day of Sir Frederic Treves and it is still true.

It is important, therefore, to examine critically all other factors which may affect the outcome. Among the technical procedures, enterostomy has been perhaps the most warmly advocated. Extravagant claims have been made for it by certain writers. But enterostomy, like any other surgical procedure, must be used in the right way and at the right time to be most effective. And its effectiveness cannot be confirmed by enthusiastic impressions but only by carefully checked statistical evidence.

But here again the time element appears. In order to show that enterostomy has been instrumental in lowering the mortality of one series of acute ileus cases as compared with another, it must be shown also that the improvement was not due merely to earlier operation, in other words, that the two series compared include about the same proportion of late cases. The present paper is an attempt to do this.

An analysis of all cases of acute ileus operated upon during the period to be examined is first prepared. Part of such analysis is shown in Table I. Thus analyzed the cases are listed in groups based on the elapsed time between onset and operation (See Table II). From these lists one readily picks out cases that have been treated by enterostomy, and classifies the cases into enterostomy or non-enterostomy groups and determines the percentage of late cases in the whole series and in the two component groups.

Such an analysis has been made of the acute ileus cases operated upon during the past twelve years at the Presbyterian Hospital in New York City.

* Read before the Southern Surgical Association, December, 1928.

TABLE I
Acute Ileus Series
Analysis of Case Histories

No	Diagnosis	Time O-A and A-O	Operation	E or Non-E	Condition of Bowel	Recover- ed	Died	Age	Apparent Cause of Death	Remarks
36662	Acute ileus peritoneal abscess, pelvic gangrene of intestine	Not stated P P A V S L	Drainage of abscess	Non E	Gangrene		+ 36 hrs post op	50 yrs	Gangrene of colon beyond colostomy	Apparently a hopeless case. Gangrene of distal loop colostomy
67643	Acute ileus peritoneal adhesions, broncho pneumonia, thrombophlebitis, saphenous vein	36 hrs O A 2½ hr A O	Jejunostomy enterostomy	E worked well	Markedly congested and distended	+		16 yrs		Both ileostomy and jejunostomy worked well. Difficult case with matted adhesions. Tried Holdens bowel evacuation unsuccessfully.
69847	Acute ileus Ca of transverse colon. Acute uremia chronic ileus	15 hr O A 39 hr A O	Cecostomy (primary) partial colectomy colocolostomy	E worked well	Distended		+ 7 days after 1st op 21 hrs after 2nd op	59 yrs	Acute uremia	Admitted to medical ward explains delay in this case. Recovered from acute ileus but died following colectomy.
57878 1st Admission	Chronic appendicitis, peritoneal adhesions, acute ileus (post op)	3 to 5 days O O	Appendectomy enterostomy (secondary) division of adhesions	E drained well	Distended	+		60 yrs		Delay due to ileus being remittent type and partly yielding to palliative treatment. Enterostomy done five days after appendectomy worked well.
57878 2nd Admission	Acute ileus peritoneal adhesions lateral hernia	Not noted	Exploratory celiotomy, partial enterectomy, enterostomy	Non E	Distended and wall thinned out	+		64 yrs		Four years after previous acute ileus. No history P D Dr.
69626	R I I H strangulated acute ileus	7 hr O A 2½ hr A O	Repair of hernia	Non E	Several infarcts Distended	+		18 yrs		
67979	Acute ileus peritoneal adhesions, peritoneal band	3 days O A 14 days A O	Division of adhesions	Non E	Slight distention	+		35 yrs		Acute ileus subsided under palliative treatment and exploration was delayed two weeks to get him into better condition. Definite obstruction by band.
69048	Acute ileus, disruption of operation wound	48 hr O O	Exploratory celiotomy, Suture of disrupted operation wound, Jejunostomy	E	Slight distention		+ 20 hrs post op	56 yrs	Shock from disruption and operation. Pneumonia? Paralytic ileus	Clinically acute ileus but no obstruction found at operation. Jejunostomy done as last resort. Disruption followed gastric lavage.

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The twelve-year period was divided into three periods of four years each. A comparison between two of these four-year periods was published in 1927.² Comparison with a third period (1924-1927) is offered in Table V. A study of this table indicates

TABLE II
Acute Ileus Series
Time—Group Analysis of Case Numbers, 1924-5-6-7
N B Letter E following a number indicates enterostomy

1-12		12-24		24-48		48-72		72 +		No Stated Time	
R	D	R	D	R	D	R	D	R	D	R	D
69626 60104 62984 58834 62011 64232 64846 69038 54436E	58866E	69073 68940 63826E 61393 66599E 61868 57572E 56524E	69937E 65635 63321	69633E 64681 67602E 59956 60956 66165E 64890 65098 65699E 64011E 59955 67357E 61364E 65205E 61863E	67643E 64270 67714 48756E 61970E 67305E	62875E 61749E 62937E 60815E 60323E 59873E 66639E	69847E 69048E 67169E 60770E 60870E 63500E 67085E 64779E	57878E 68750E 67979 69350E 68496E 68289E 68390 46089E 66076E 64668E 60878E 65071E 66644E 60518 66240E 58793 58663E 61408E 61398E 63877 63566E 65930 64633E 56366E 67139E 64832E 64932E 65035E 65748E 60759E 58868E 58496E 65259E 50788E 67281E 67079E	57878 60815E 35550	36662 53244E 58943E 53244E	
9	1	8	3	15	6	7	8	18	26	3	1 Series
1	1	4	1	9	4	7	8	13	23	1	3 Enterostomy
8	0	4	2	6	2	0	0	5	3	2	1 Non-E

	Total Cases	Recovered	Died	Mortality—Per cent
<i>Series</i>	108	60	18	44.4 (61% late cases)
Enterostomy Grp	75	35	40	53.3 (73% late cases)
Non-enterostomy Grp	33	25	8	24.2 (33% late cases)

1 That the diagnosis of acute ileus is being made more frequently. Shown by increase in number of cases in later periods.

2 That the diagnosis is being made a little earlier. Shown by smaller percentage of late cases in later periods.

3 That the average mortality has been materially reduced during the last eight years and especially during the last four years.

4 That enterostomy is being used more frequently as an adjunct in the treatment of these cases (one-third of the cases in first period—one-half of the cases in second period—three-quarters of the cases in third period).

5 That about the same number of cases in each period did not have enterostomy done

Further study of the table shows

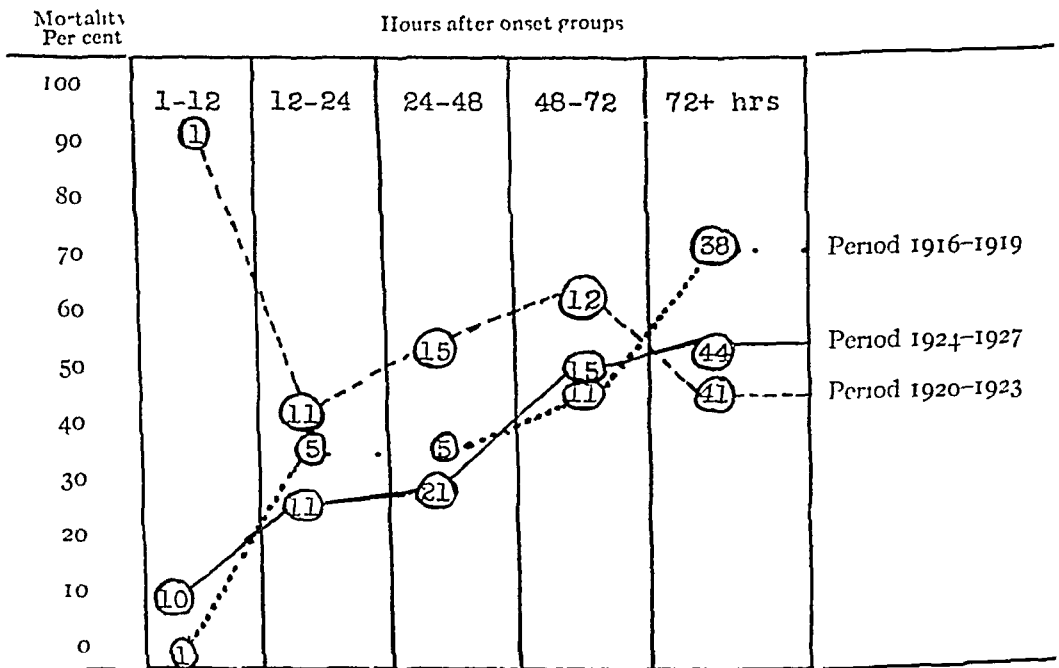
1 That there has been a greater reduction in the average mortality of the cases treated by enterostomy than in those not so treated (38 per cent lower in enterostomy group, 29 per cent lower in non-enterostomy group)

2 That the reduction in average mortality of the whole series may be accounted for (in part, at least) by the reduction in percentage of late cases (Late cases reduced 20 per cent, mortality reduced 22 per cent)

3 That the reduction in average mortality of non-enterostomy group may be accounted for very largely by the reduction in percentage of late cases

TABLE III
Acute Ileus Series

Time—Mortality Curves (compared) for Three four-year Periods
Shows average mortality rate rising with increased delay between onset and operation



N B—Numbers in circles indicate number of cases in each hour group

in this group Late cases reduced 59 per cent Mortality reduced 29 per cent

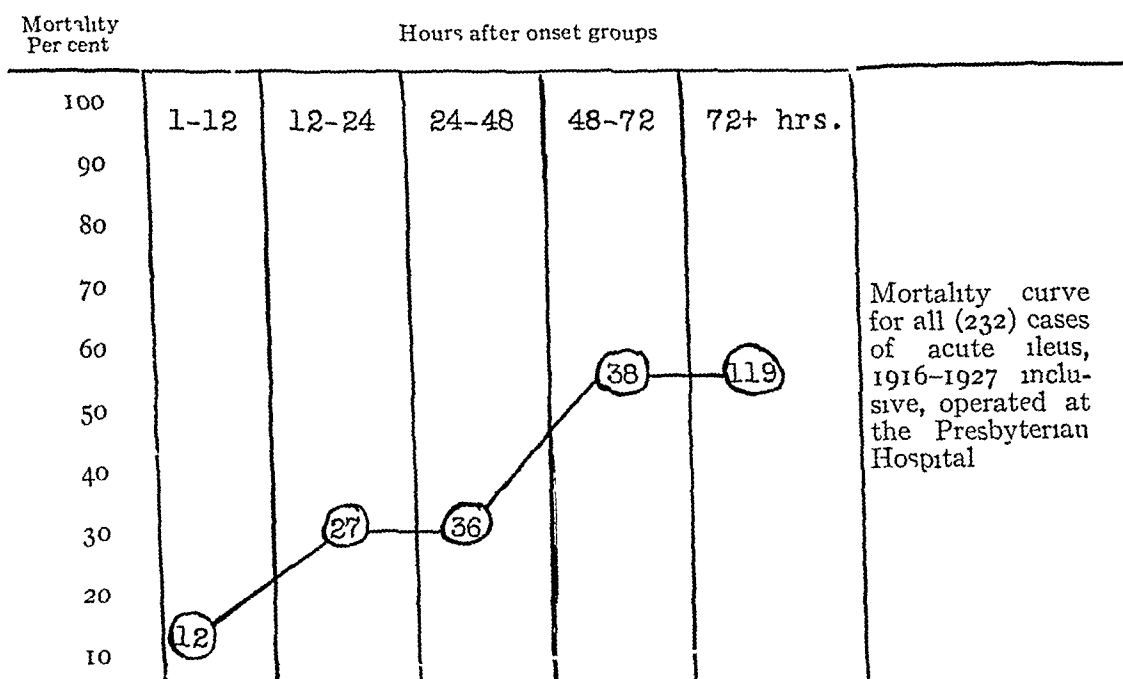
4 That the reduction in average mortality of enterostomy group cannot be accounted for in this way Late cases increased variable per cent Mortality reduced 38 per cent

This last observation appears to be of real significance It has been seen in Tables III and IV that the average mortality of cases of acute ileus operated upon later than forty-eight hours after onset is greater than the average mortality of those operated upon earlier than forty-eight hours after onset Therefore it appears obvious that when the percentage of late cases is increased in a group, the average mortality for that group of cases must also be increased unless some other factor than the time element steps in to

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alter the expected result. Now in this enterostomy group of acute ileus cases at the Presbyterian Hospital the percentage of late cases during the two later periods is greater than during the first four-year period examined. We should therefore expect the average mortality to be greater. But the contrary has happened. The average mortality has materially decreased. Comparing the second period with the first, we find that the late cases increased 15 per cent while the average mortality decreased 13 per cent. Comparing the third period with the second, we find that the late cases decreased 6 per cent while the average mortality decreased 20 per cent. Here we may say that part of the average mortality decrease is due to a larger percentage of early cases in the third period than in the second. But this can only partially explain it for

TABLE IV
Acute Ileus Series
Time—Mortality Curve for Twelve-year Period



N B—Numbers in circles indicate number of cases in hour group

the fall in mortality is three times greater than the fall in percentage of late cases. Comparing the third period with the first we find an increase of 9 per cent in the number of late cases but a decrease of 38 per cent in the average mortality. Part of this decrease in mortality may be due to the fact that the enterostomy group of the third period is three times larger than that of the first period and therefore less influenced by the possible factor we call luck (*i.e.* the small group of the first period may have contained a relatively large proportion of unusually bad cases). But even allowing for these factors it appears that the discrepancy is too great to be accounted for in this way. A logically to-be-expected increase in average mortality has been replaced by a definitely marked decrease in the enterostomy group of cases. What factor is responsible for this? Certainly there has been some change in the adjuvant treatment in cases of acute ileus (whether with or without

enterostomy) during the past eight years. Greater pains have been taken to protect these patients against cold and shock, to reduce intestinal distention before and after operation, to support the circulation and to replace water losses. But these while very important are not one feels, the critical elements involved. There is evidence indicating that the most important factor of danger in acute ileus cases is intestinal damage³ leading to absorption toxemia or perforation peritonitis. Intestinal damage is primarily due to intestinal over-distention (in non-strangulated cases, at least). If these statements are

TABLE V
Acute Ileus Series
Comparison of Mortality by Four-year Periods
Entire Series

No. of Cases	Period	Mortality—Per cent
60	1916-1919	66.6 (81% late cases)
80	1920-1923	53.7 (66% late cases)
108	1924-1927	44.4 (61% late cases)

"Late cases" are those allowed to go more than forty-eight hours without operation

Enterostomy Group

No. of Cases	Period	Mortality—Per cent
22	1916-1919	90.9 (64% late cases)
38	1920-1923	77.7 (79% late cases)
75	1924-1927	53.3 (73% late cases)

Non-enterostomy Group

No. of Cases	Period	Mortality—Per cent
38	1916-1919	52.6 (92% late cases)
42	1920-1923	34.0 (55% late cases)
33	1924-1927	24.2 (33% late cases)

correct whatever means is most effective in preventing or relieving this over-distention is therefore the most important factor in removing the danger. The critical factor in decreasing the average mortality. Enterostomy, done at the right time and in the right way, is the most effective means we have at present to relieve and to prevent intestinal over-distention and anæmia. Now, in the groups of cases here presented, the group treated by enterostomy has shown a slightly larger decrease in average mortality than has the group not treated by enterostomy. Moreover, it must be noted that the decrease in the average mortality of the non-enterostomy group was predisposed to by a marked decrease in the percentage of late cases while this was not true of the enterostomy group. The adjuvant treatment was similar in both groups of cases. Therefore it seems fair to assume that the enterostomy procedure itself was

the critical factor in lowering the average mortality of the group of cases so treated. And, because the enterostomy group was more than twice as large as the non-enterostomy group it assumes greater responsibility for lowering the average mortality of the entire series of acute ileus cases. Thus, it would appear that the performance of enterostomy on a large proportion of the cases in the series of acute ileus cases at the Presbyterian Hospital in the period 1924 to 1927 did definitely influence the average mortality in a favorable manner.

Conclusion—There is statistical evidence to indicate that enterostomy is of value in the treatment of Acute Ileus.

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ILEUS FOLLOWING RIB FRACTURE

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REPORT OF CASE—Male, fifty-three years of age Negative medical history September 18, 1928, while riding on a street car, he fell, striking his chest against the edge of a step Immediately after this he drove fifteen miles to his suburban home to see a physician, who took him to a hospital where an X-ray examination showed fractures of the eighth and ninth ribs on the left side The chest was strapped with adhesive and the patient went home On the following day the patient suffered no pain of any consequence He had a normal bowel movement, but by noon he began to become slightly distended On the following day there was no bowel movement and the distention was increased That night there was a projectile, ill-smelling emesis The third day after the accident, there was still no bowel movement and the distention became even more marked By this time the vomitus had a faecal character The patient appeared to be very ill with elevation of pulse rate and temperature The man was moved to the Evanston Hospital, where the abdomen was explored through a left rectus incision The small bowel was found to be markedly distended but careful search failed to reveal any obstruction The abdomen was closed without drainage and without the performance of an enterostomy The post-operative course was stormy There was marked distention and gastric dilatation, the latter being evidenced by the accumulation in the stomach of brown, ill-smelling fluid During the first twenty-four hours the treatment included the following Four "1-2-3" enemata, three lavages, two hypodermoclyses, proctoclysis, hot turpentine stupes, small doses of milk of magnesia, seven ampoules of pituitrin two ampoules of digifolin On the second post-operative day four enemata, one hypodermoclysis, and two ampoules of pituitrin and three ampoules of digifolin were given On the third day the patient began to expel flatus freely and from then on his convalescence was uneventful He walked out of the hospital on his fifteenth post-operative day

A careful search of the literature reveals but four other cases These cases together with the author's are summarized in Table I It will be noted that the patients were all males The ages varied from forty-three to sixty-six, the average being fifty-six The symptoms of all cases were very similar cessation of bowel movements, increasing distention, and vomiting A pre-operative diagnosis of intestinal obstruction was made in four cases, in one, mesenteric thrombosis Four cases recovered and one died Laparotomy was done in all cases In three cases, enterostomy was done and all recovered In the two cases where enterostomy was omitted, one (the author's case) recovered and one died From this very small group of cases it would seem that enterostomy might be the safer procedure, although the very energetic post-operative treatment given in the author's case may account for his recovery Whereas it might seem from the author's case that recovery might be possible without operation, such a course could never safely be taken where the liability of mechanical obstruction is so great The employment or omission of enterostomy must vary with the judgment of the surgeon Perhaps a larger series of cases in the future will throw light upon this question

ILEUS FOLLOWING RIB FRACTURE

TABLE I

Author	Date	Sex	Age	Occupation	Previous history	History of present illness	Examination and course	Diagnosis	Operation	Post operative course	Result
Adams, J E ANNALS OF SURGERY 1910 Vol II, p 102	1907	M	66	Inter-preter	Negative blood from rectum on two or three occasions	Three days before admission to the hospital patient fractured 8th 9th 10th ribs on right side near bannister Ribs were strapped since accident despite lavomitus on third day Dark	Excess of fat Pulse 120, respiration 40, temperature 99.6 Some tenderness distended iliac fossa	Intestinal obstruction? Carcinoma of iliac colon?	Right iliac incision No distention result Same left-sided incision Closure without drainage	Vomiting profound shock disturbed mental Perityphilitic abscess caused evacuation of feces and flatus	Died forty-eight hours after operation Post-mortem Small bowel and cecum distended, no obstruction recovered
Ralphs F G Brit Jour Surg 1926 Vol VII, p 559	1926	M	60	Store-keeper	Negative	Fell eighteen feet from ladder and sustained fracture of 8th and 9th right ribs near their angles Severe contusion of back Admitted to hospital day of accident	Bronchitis treated by steam heat, abdomen distended on third day, respiration 32, no bowel movement since admission Flatus, fourth day a little hicough vomiting, cyanosis feeble rapid pulse	Intestinal obstruction	Gas and fluid withdrawn from most distended loop by needle T-tube Intermittent evacuation later winged catheter inserted in loop	Patient comfortable two days after operation Puscula healed eighth week	
Landell, D T J A M A, MAYVII, p 169	1926	M	43		Negative	Six days previous to admission patient slipped on pavement on right side and fell heavily after Bowels failed to act on fifth day patient became distended	Subcutaneous emphysema X-ray, fractured 12th rib between angle 6th and 7th Great distention and sterility increased normal Discontinuation of pituitary following day after admission	Intestinal obstruction	Anasthesia local Distended loops sutured to peritoneal cavity catheter tied in place	Bowels moved normally fifth day, wound healed in five weeks	Recovered
Christopher F 1928	M	53	Attorney	'Plomarine poisoning' in 1910	September 18 1928, patient fell while on a street car and struck chest against automobile fifteen miles to west of St. Louis X-ray showed fracture of the 8th and 9th ribs left side, posterior axil-	September 19 1928 normal slight movement by noon, September 20 1928 no pain, tension, projectile ill-smelling emission at night dyspnea increasing distention, facial vomiting	Mesenteric thrombosis, perforation of gut, rupture of diaphragm Intestinal obstruction Sept 1 1928 Left rectus tendens small intestine Splenic region explored No obstruction found Closed ure without drainage	Stomach Frequent turpentine enemas and enema Hydropneumothorax Walled out of hospital fifteenth day post operative	Recovered		

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The mechanism of the production of the ileus is not clear in these cases. In 1906 Starling (quoted by Adams) said "Stimulation of the splanchnic causes complete relaxation of the lower part of the ileum with the rest of the small bowel but it produces a strong contraction of the muscle fibres forming the ileocolic sphincter." Where the fractures are close to the sympathetic chain it is conceivable that the latter might become irritated. But in Ralphs' and the author's cases the fractures were some distance from the vertebral column. Moreover, as pointed out by Ralphs, there are many cases of rib fractures, both single and multiple, which are not accompanied by ileus. Hypotheses suggested by Ralphs are an inhibition of peristalsis by irritation of the abdominal sensory nerves or traumatic hæmia with fat embolism.

VON RECKLINGHAUSEN'S DISEASE

WITH SARCOMATOUS DEGENERATION OF A DEEP FIBROMA

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VON RECKLINGHAUSEN'S disease, or "multiple neurofibromatosis," has been termed a constitutional anomaly. In 1849, R. W. Smith first described the gross anatomic characteristics. Virchow, in 1863, found that the tumors had their origin in the connective tissue of nerves. In 1882, von Recklinghausen grouped the signs and symptoms into a disease unit, characterized by multiple cutaneous tumors, pigment anomalies, and elephantiasis-like formations. There are associated congenital malformations, psychic disturbances, and often more or less characteristic bone changes. Herbitz states that one-fifth of his cases had an hereditary basis.

The disease is rare, but four cases appearing in the records of the combined First Medical and Surgical Services of



FIG 1.—Showing asymmetry of face areas of pigmentation, and several small scattered cutaneous fibromata.

the Bellevue Hospital during the past ten years. The following case is of interest as it embodies practically all of the lesions described by the various writers on the subject, including malignant degeneration of a deeply seated tumor. Added interest lies in the fact that although careful search was made for nerve tissue in many so-called "neurofibromata," in only one specimen, that from the iliohypogastric nerve, was any evidence of neurogenic origin found.

CASE HISTORY.—H. H., Bellevue Hospital, 6220, twenty-two years of age, German, painter by trade. Admitted to the First Surgical Division March 1, 1927.



FIG 2—Note the difference in size and shape of the ears, the occipital tumor, the compensatory scoliosis, the pigmentation which is most marked about the wrist, and in the left subscapular region, a large pigmented, cutaneous fibroma.

the right ear was larger and more protruding than the left. In the occipital region there was a hard, rounded, slightly movable mass eight centimetres in diameter, attached deeply. Over the back, chest, abdomen, and upper thighs there were scattered areas of dark brownish pigmentation varying from one-half to three centimetres in diameter. Over the same areas there were many soft cutaneous tumors, some slightly raised and pigmented, others flattened and without pigment. There was an irregular, soft, angiomatous mass in the region of the right ankle. There was marked enlargement of the right tibia and of the bones of the right foot, the tibia being three centimetres longer than its fellow on the left. There was a compensatory scoliosis. No abnormality of the internal organs or of the genitalia was noted. X-ray plates of the right lower extremity showed irregular enlargement of the tibia and fibula with what appeared to be small bone cysts about the epiphyses (Figs 1, 2, 3 and 4).

There was no family history of a similar condition. From birth there had been an enlargement of the soft tissues about the right ankle and foot. During his youth the patient had noticed the gradual appearance of pigmented areas over the body and of soft, painless nodules scattered over the back, chest, abdomen, and extremities. Five years before admission he noted a pea-sized nodule over the occiput which did not increase in size until two months previous to admission. It was the subsequent rapid growth of this nodule which brought the patient to the hospital.

Physical examination showed a robust man of twenty-two, not acutely ill. He appeared mentally below par. There was asymmetry of the face with flattening of the left malar bone. The left eye was placed slightly lower than the right, and the

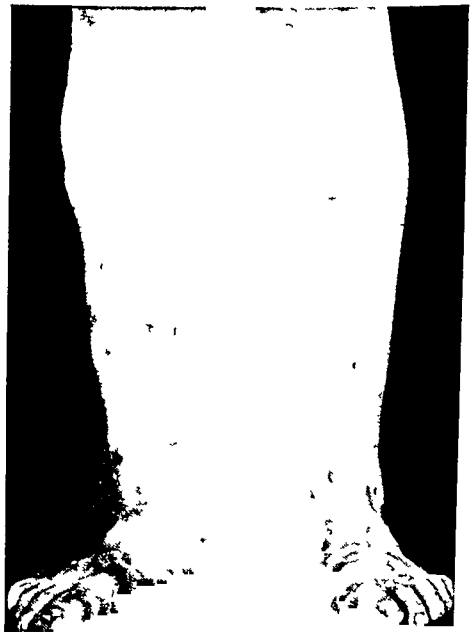


FIG 3—Asymmetry of the bones of the lower leg with overgrowth of right tibia, fibula, and bones of the foot. Note the large fibromatous growth about the right ankle.

A diagnosis of von Recklinghausen's disease with sarcomatous degeneration of a "neurofibroma" was made

Operation March 4, 1927

The occipital tumor was removed and found to consist of firm, lobulated fibrous tissue, encapsulated save at the base where it merged with muscle. There was no evident involvement of the bone. A cutaneous nodule from the chest wall and one from the thigh were also removed. Radiotherapy was advised but the advice was disregarded.

Pathological Report —

(a) Occipital tumor "The specimen consists of a lobulated, circumscribed, apparently encapsulated mass eight centimetres in diameter. On section the tumor is moderately dense and consists of two lobes, each surrounded by its own thin but firm capsule. The cut surface is glistening white and shows a mass of fibres arranged in the form of whorls. Microscopically, the tumor is com-

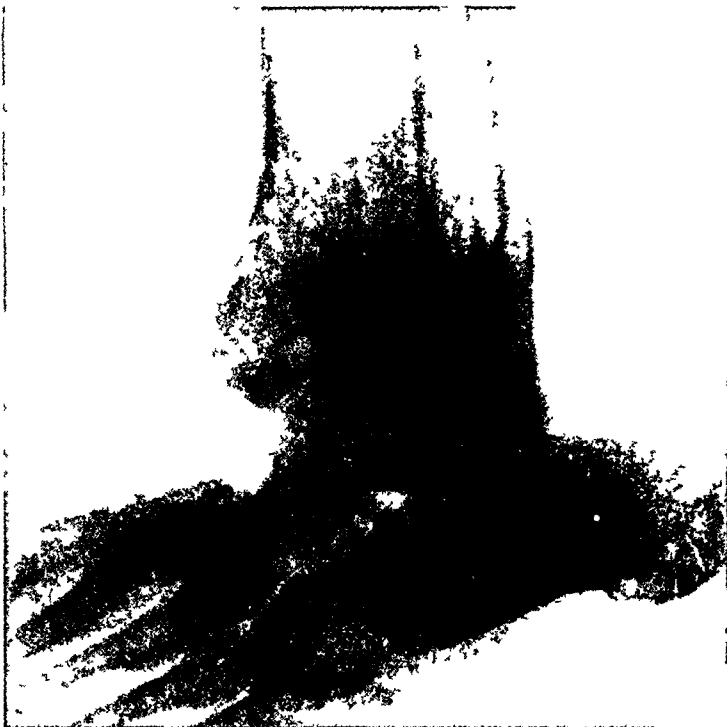


FIG 4—X ray of right foot and ankle showing the deformity of the bones with the presence of "bone cysts" in the lower third of tibia and fibula



FIG 5—Occipital tumor at time of first removal

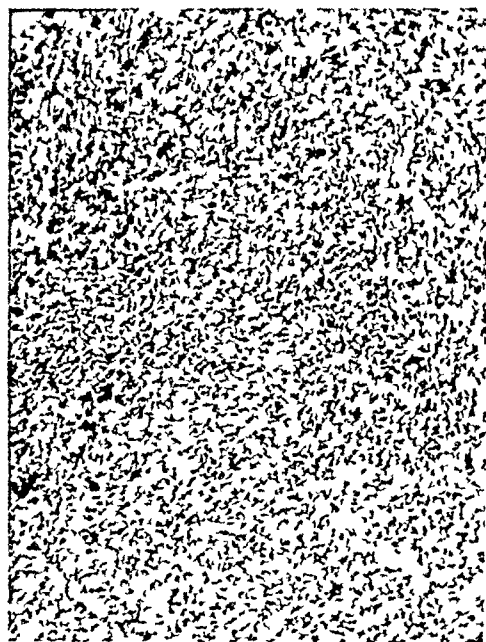


FIG 6—Section of fibroma of chest wall

posed of both fibrous and cellular areas. The former consist of an interwoven mass of slender fibrils which closely resemble collagen fibres, the latter of long spindle cells. The nuclei of these cells are rounded, moderately hyperchromatic, and show an occa-

sional mitotic figure. The tumor as a whole is relatively avascular. The few blood vessels present are well formed and are lined by endothelium. *Diagnosis—Fibrosarcoma*" (As the result of a recent study of a large series of fascial tumors, the micro-

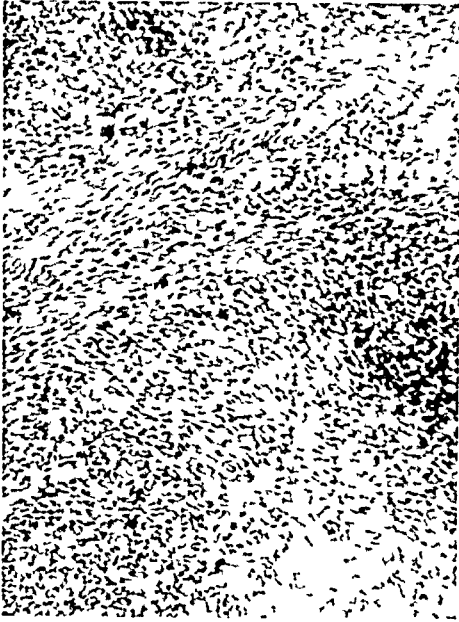


FIG. 7—Occipital tumor at time of second removal. (Compare with Fig. 5)

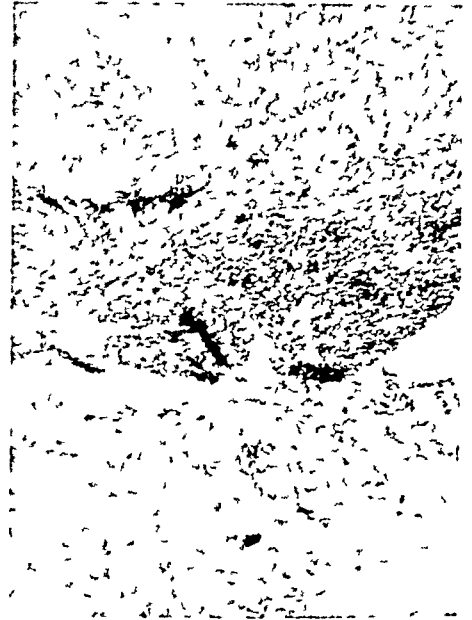


FIG. 8—Metastatic growth in pleura and adjoining lung substance

scopic picture of many of which was similar to that of the one just described, it was felt that this tumor was of the locally malignant type as opposed to the purely benign or to the metastatic (Fig. 5)

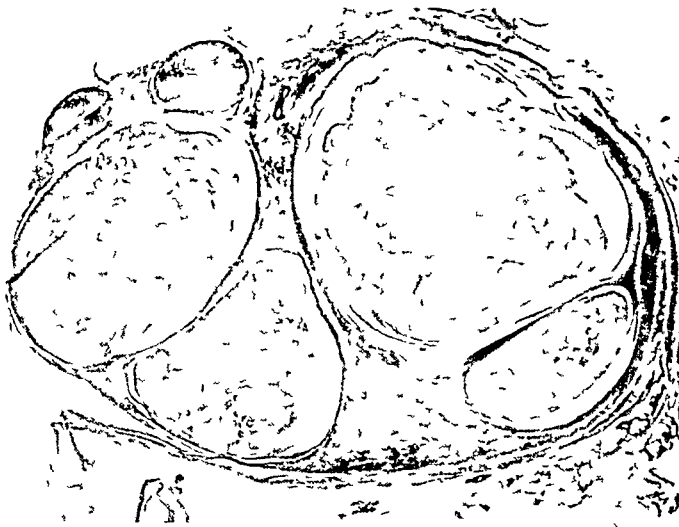


FIG. 9—Neurofibroma of iliohypogastric nerve

(b) Tumors from chest wall and thigh. "That from the chest wall consists of a tough structureless mass of glistening white tissue replacing the subcutaneous fat and surrounded by an elliptical area of skin and subcutaneous tissue nine by five by one centimetres. The specimen from the thigh is similar as to gross appearance. Microscopically, the tissue of both specimens is rather cellular and consists of a mass of finely interwoven fibrils with prominent, moderately hyperchromatic nuclei. No mitotic

figures are seen. The intercellular substance stains faintly and is finely granular. *Diagnosis—Fibroma*" (Fig. 6). Through the kindness of Doctor Stevenson, sections were stained for nerve fibrils by the methods of Cajal, Molnar, and Loyez. No nerve tissue was demonstrated. If no demonstrable evidence of neurogenic origin be present, it would seem a misnomer to refer to these tumors as 'neurofibromata,' basing the diagnosis on the probable site of origin rather than on the actual cellular make-up.

Eight months later the patient returned with the history of reappearance of the occipital growth two months previously. It was now practically the same size as at the time of his first admission. There was no change in the nature of the other tumors and the cutaneous masses which had been excised had not recurred. Second resection of the occipital mass November 17, 1927. The tumor was softer and more vascular. There was more extensive invasion of the muscle and erosion of the outer table of the skull. Radiotherapy was again refused by the patient.

Pathological Report—"The specimen consists of an elliptical mass eight by four by three centimetres. On section, the tissue is extremely vascular and of a soft spongy consistency. The cut surface is grayish-white in color and has a somewhat trabeculated appearance. There is evidence of invasion of the scalp muscle. Microscopically, the tissue is exceedingly cellular and made up of short spindle cells arranged somewhat in the form of alveoli. Scattered throughout the section are circumscribed areas of degeneration. The blood supply is excessive with innumerable dilated blood sinuses lined by tumor cells. *Diagnosis*—Spindle-cell sarcoma" (In comparing the microscopic picture of this neoplasm with that of the original, the anaplastic changes which have occurred during a period of eight months are strikingly apparent.) (Fig 7)

The final admission was four months later with the history of reappearance of the tumor one and one-half months previously, followed by rapid growth. The patient complained of constant headache and a slight unproductive cough. At operation it was found that the mass had perforated the skull and that the tumor tissue formed a heavy plaque over the occipital portion of the dura. There was considerable loss of blood and, in spite of transfusion, the patient died twelve hours following operation.

Autopsy—"The occipital mass presents a picture similar to that on the previous admission. There is direct extension to the occipital portion of the dura with distant metastases to the visceral pleuræ, which are studded with firm whitish sarcomatous nodules. There is a small tumor arising from the sheath of the left iliohypogastric nerve which on section shows interlacing strands of fibrous and nerve tissue. The thymus is large and fleshy and weighs thirty-five grams. The remainder of the report corresponds with the physical findings on admission. *Diagnosis*—von Recklinghausen's disease, spindle-cell sarcoma of occipital region with extension to the dura, metastatic sarcoma of visceral pleuræ and adjoining lung, cutaneous fibromata of trunk and extremities, neurofibroma of iliohypogastric nerve" (Figs 8 and 9)

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HEMIRESECTION OF A SOLITARY KIDNEY*

By THOMAS N. ILPBURN, M.D.

OF HARTFORD, CONN.

PARTIAL renal resection where there is a second normal kidney is an uncommon operation. Partial renal resection where there is no other kidney must be a very uncommon operation, as I can find only one case reported that reported by Judd (in 1925) in the *ANNALS OF SURGERY*, vol. LXXVII, p. 458.

Judd resected the upper third of a single type kidney for stone and infected

upper calices, in a woman, thirty-two years of age. The function of the kidney was normal before operation. The immediate effect of the operation was to run the blood urea up to 92 on the fourth day. Then the function returned to normal and the woman went successfully through a hard childbearing the next year.

I wish to report a case of resection of one-half of a solitary kidney of the double type.

CASE—A man, forty-two years of age, entered the Hartford Hospital December 23, 1925, complaining of anuria and pain in his right kidney. His left kidney had been removed ten years before for stones. His present attack began three days previous to




FIG. 1.—Pyelogram showing congenital double right kidney. Left kidney removed surgically seventeen years previously. Note shadow of large stone in upper kidney and shadow of small stone blocking conjoined pelvis.

admission and he had passed no urine since. His temperature was 102°, pulse 110, leucocytes 17,000—80 over 20, blood pressure 130/90, non-proteid nitrogen 88.2 milligrams, creatinin 6. The man appeared acutely ill—with intense nausea and dry tongue.

A catheter passed up to the right kidney brought very pussy urine, flowing under pressure. The X-ray and pyelogram are shown in Figure 1.

Here was a man with a solitary double kidney with bifid pelvis. The upper kidney was completely filled with a stone cast, part of which had broken off and blocked the

* Presented before the New England Urological Association, May 1, 1929.

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ureter at the junction of the bifid pelvis, causing an infected hydronephrosis of the lower good kidney

The ureteral catheter was allowed to drain for twenty-four hours when it became blocked, making necessary an operation through a right lumbar incision to remove the obstructing stone, which was done without complication. The man recovered, and when his non-proteid nitrogen had returned to normal I advised a heminephrectomy, but he and his family declined. He left the hospital twenty-six days after admission.

Thirty-nine days later, February 27, 1926, he returned again with the same symptoms and a history of anuria for four days. His temperature was 103° , pulse 100, leucocytes 16,000—85

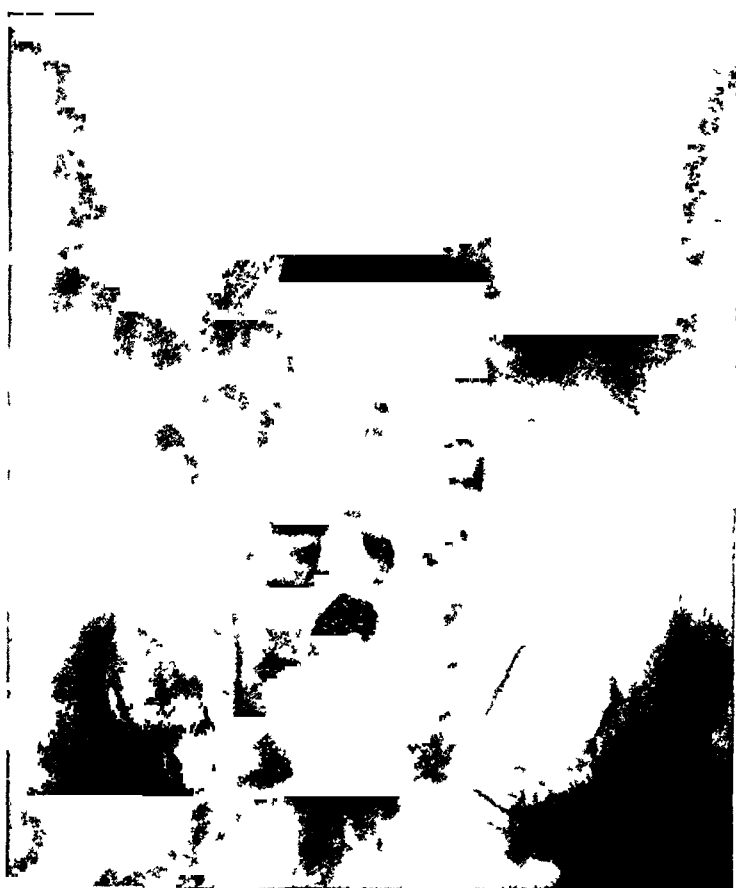


FIG. 2.—Pneumogram taken sixty three days after heminephrectomy. Pelvis and ureter still distorted by blood clot.



FIG. 3.—Pneumogram three and one half years after heminephrectomy.

over 15, non-proteid nitrogen 55. He was intensely nauseated and looked ill. The X-ray showed that another fragment of the stone cast had broken off and blocked the bifid ureter. Immediate and radical resection of the upper kidney along with the removal of the obstructing stone was advised and accepted. This was done through a lumbar incision, taking twenty-two minutes to complete. Drains were put down to the upper pole of the kidney and to the incised ureter. Figure 4 shows the stone cast in the removed half.

This man soaked his dressing with urine for three days then began to void normally, passing no more urine through the wound. His wound was firm in twenty-three days following

the operation. He left the hospital twenty-eight days following the operation. When he left his non-proteid nitrogen was normal and his phenolsulphonephthalein output was 22 per cent in two hours.

Five weeks following this discharge he returned with hematuria. Cystoscopy showed the blood to be coming from the ureter, and the pyelogram showed the picture in Figure 2. This bleeding quickly cleared up. The patient returned at my request April 20, 1929, for pyelogram and function. He never felt better. His phenolsulphonephthalein is 48 per cent in two hours and his pyelogram is shown in Figure 3.



FIG 4—Stone removed from upper kidney after resection

Urology, vol 1, pp 17-57, 1917

his heminephrectomy. The phenolsulphonephthalein output was 20 per cent from the good kidney and 10 per cent from the bad side in one-half hour. Four months following his operation, the output was only 5 per cent on the operated side in one-half hour. There was no report after that.

Judd has done a heminephrectomy in six cases where there was a functioning kidney on the other side. In three of these cases he has later had to remove the remaining half because of atrophy.

Judging from the clinical material which has been reported so far in enough detail to draw conclusions from, it would seem that Hinman's experimental work on compensatory function and disuse atrophy of kidneys is borne out. Unto the kidney that hath shall be given and the kidney that hath

In studying this case, by far the most interesting finding is the compensatory function in the remaining kidney, a function of 48 per cent in two hours.

Now let us compare this functional result with almost an identical case reported by Doctor Young in the *Journal of*

The case of Young had a good kidney on the other side and there was no emergency operating as there was no obstruction to the ureter, so that Doctor Young could fortunately do a differential renal function before

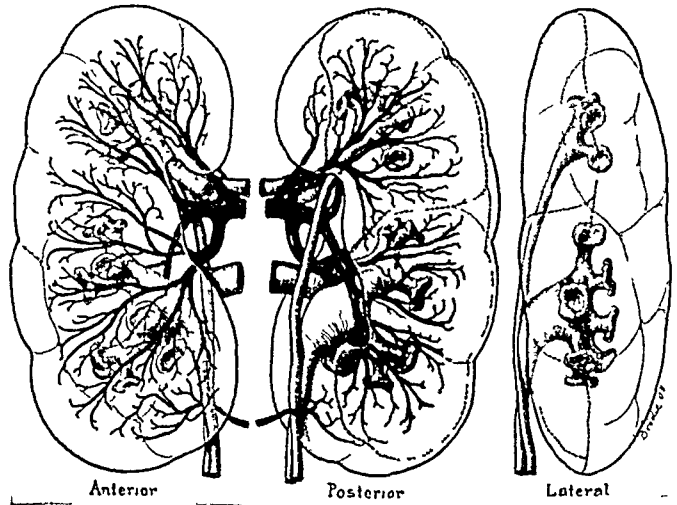


FIG 5—Three views of corrosion preparation of kidney with double pelvis. This represents, like the preceding figures, a type form. Note how complex the arterial circulation has become. There are now two posterior arteries, each skirting the renal pelvis as in a normal case. The lower posterior artery runs obliquely backward between the two renal pelvis. The shaded areas represent the territory of the posterior vascularization. (From Kelly and Burnham)

HEMIRESECTION OF A SOLITARY KIDNEY

not shall have taken from it even that that it hath The surgical principles, therefore, become quite definite in regard to partial resection of kidneys First, do not resect part of a kidney if there is a good kidney on the other side Second, resection of the diseased part of a solitary kidney may give the remaining good part of the kidney an opportunity to compensate up to normal I will say nothing about that large group of cases where there is bilateral renal pathology Certainly, until we know to the contrary, this is a fertile field for conservative surgery

In regard to the surgical technic of heminephrectomy in the double kidney type, I wish to suggest a method differing from both Judd and Young

Judd says, "The vascular connections to the normal segment are first examined to make sure they are adequate The pedicle to the remaining segment is then clamped cut and ligated The kidney should be resected through normal tissue, and a portion of this tissue left attached to the segment to be removed in order to avoid possible error and infection

The renal stump is closed with double interrupted or mattress sutures" He uses a knife in the resection

Young says, "The vessels supplying the portion to be excised are ligated and divided Incision is made at the junction between the healthy kidney and the diseased portion' He uses a knife cuts a V-shaped hollow in the end of the kidney, takes great pains in curetting and closing calices that may be opened into, and closes the end with mattress sutures

The blood supply in thirty-five cases of double kidney were shown by Eisendrath to be "one artery in fifteen cases two arteries in fifteen cases and three arteries in five cases' Figure 5 from Kelly and Burnham, shows Broedel's work on the blood supply of double kidneys In my case of heminephrectomy, the patient was in a very desperate condition and the length of

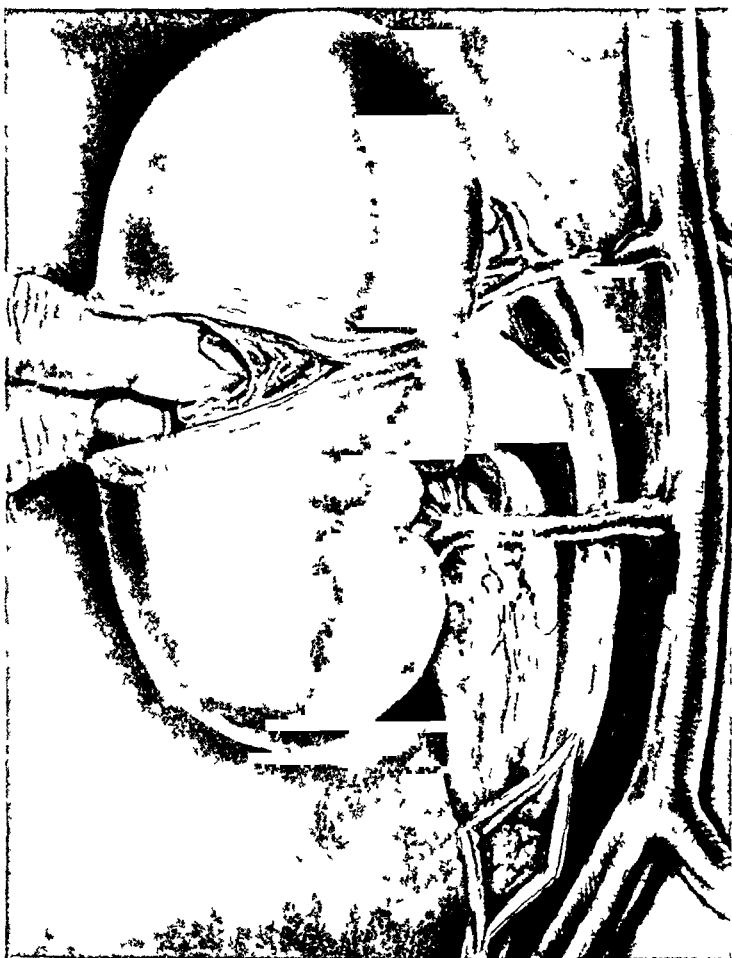


FIG 6—Showing method of relocating double kidneys with slight bleeding or danger of opening calices, and before ligating the pedicle

time under an anæsthetic was an important factor. There was so much congestion and perineal inflammation that to isolate the pedicle and identify the blood supply would have been a dangerous and difficult procedure. The furrow between the two kidneys was marked and after nicking the capsule in the furrow I found it as easy to separate those two kidneys with my finger (Fig 6) as to enucleate an adenoma of the prostate. The line of least resistance is between the endings of the blood vessels. There was only a slight oozing of blood. No calyx was broken into and the upper pus sack was unruptured. When the two kidneys are separated then the pedicle can be safely tied. The oozing from the raw end of the kidney was controlled by the slight pressure of mattress sutures—no attempt being made to close over the raw surface. A cigarette drain was put down to this surface, and no attempt was made to cover it with fat. The fact that my case had a urinary sinus only three days in spite of his pyelotomy, I think justifies the simplicity of the procedure.

SUMMARY

- 1 Partial nephrectomy of a solitary kidney can be successfully done with marked improvement in the function of the remaining portion of the kidney.
- 2 Partial nephrectomy is not a good surgical procedure if there is a good kidney on the other side—because its function gradually diminishes, due to disuse atrophy.
- 3 Where both kidneys are diseased we have so far no cases of bilateral partial resections. This would be a most interesting group to get evidences of functional reactions on.
- 4 The simplest and safest method of heminephrectomy of the double kidney type for acute pathological conditions is to separate the two halves by blunt dissection with the finger. The kidney cleavage will be at the point of least resistance, *i e*, between the terminals of the blood vessels. This avoids the danger of destroying the circulation to the good kidney, and of cutting into calices. A few pressure mattress sutures to control the oozing of blood are all that is necessary to place in the cut end and it is not necessary to cover the raw end with renal capsule.

RECTAL ANÆSTHESIA WITH TRIBROMETHYLALCOHOL

BY JOSEPH R. GUTTMAN, M.D.

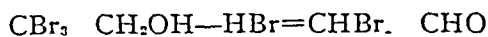
OF CHICAGO, ILL.

FROM THE SURGICAL DIVISION OF PROF. P. SUDECK, EPPENDORF KRANKENHAUS, HAMBURG, GERMANY

THE desirability of rectal anæsthesia especially in surgery of the head and neck and in the presence of pathology in the respiratory tract requires no comment. Ever since 1846 when Roux made his first attempt at rectal anæsthesia with an aqueous solution of ether, and 1847 when Pirogoff tried the rectal administration of ether vapor, numerous means have been elaborated with indifferent success in this type of surgical anæsthesia. The advent of local anæsthetics was naturally followed by a loss in interest in this method of inducing anæsthesia. However, the frequent incompetency of local anæsthesia, especially when dealing with hysterical or nervous patients together with the lack of adaptability of local anæsthesia in pædiatric surgery, has once more caused the attention to be focused on rectal induction. Gwathmey, in 1913, renewed interest in this method by publication of his ether-in-oil rectal anæsthesia, alone or in combination with hypodermic administration of morphine and magnesium sulfate. It has not become very popular due to the uncertain rate of absorption of the ether from its oil mixture, and to the fact that frequently there occurred marked rectal irritation with the production of diarrhœa, tenesmus, bloody stools and ulceration of the mucosa. However, the search for a satisfactory rectal anæsthetic has apparently been successful, due to the recent elaboration by Willstater and Dusberg of a new drug, tribromethylalcohol, also known in the German literature as E 107 or Avertin, an anæsthetic that bids fair to supplant the use of ether by the rectum. This anæsthetic as shown by the literature has been used in over 100,000 cases with such marked success as to make it appear fair superior to any method of anæsthesia at our command. The drug has not been available for use in this country but will appear in a short period of time. The European clinics have all had an opportunity of observing its efficacy and reporting their results. This communication will deal with the experience of the drug during my recent association with Professor Paul Sudeck at his surgical clinic for a period of eighteen months as well as a review of the literature emanating from the various surgical and gynæcological clinics. A brief description of the salient properties of the drug follows.

CHEMISTRY

Tribromethylalcohol is a white crystalline substance having a melting point of 79°C , easily soluble in water at 40°C . Its molecule is very labile, breaking down when heated above 45°C with the formation of dibromacetaldehyde and bromic acid. Its chemical structure as well as the products of decomposition, is shown by the following



At this time it might be well to state that the dibromacetaldehyde is a highly irritant drug that easily causes rectal inflammation, and even ulceration. The presence of the aldehyde in a solution of tribromomethylalcohol may be determined by adding to a solution of the drug a few drops of congo red. The formation of an orange color indicates that decomposition has not occurred, but the appearance of a blue color indicates the presence of the toxic dibromacetaldehyde and the solution should not be used. This test is obligatory before the solution is ever placed in the rectum.

ABSORPTION

The absorption of the drug is fairly rapid. Straub,⁶¹ working at the Pharmacologic Institute of the University of Munich, found that 80 per cent is absorbed in the first twenty minutes and 95 per cent absorbed within the first two hours of the anæsthetic. During anæsthesia Sebening¹⁷ has found it in a concentration of six to nine milligrams per cent in the blood.

ELIMINATION

In the body the drug is detoxicated by its combination with glycuronic acid and eliminated in that manner by the kidney. Straub was enabled to recover 81 per cent of the drug in this combination from the urine. Traces of bromine could be recovered from the sweat but none from the respired air or the faeces.

TOXICITY

When introduced hypodermically, perorally or by rectum, tribromomethylalcohol causes a rapid induction of anæsthesia without any preliminary excitation. Unconsciousness and muscular relaxation similar to that observed under ether follows. Recovery from the anæsthetic is not comparable in any way to that observed with ether. Post-anæsthetic upsets are not seen, and experimental animals, and even man, recover in a way that is similar to a person awakening from a deep sleep. Lendle³³ has found that the toxic dose by rectum for the various laboratory animals is 5 to 6 gram per kilo body weight, and the anæsthetic dose for these animals is 25 to 30 gram per kilo body weight with a consequent therapeutic index above 1.7. He also compared the relative toxicity of the drug with various anæsthetics such as chloroform, ether, Gwathmey's ether-oil, morphine and magnesium sulfate anæsthesia, and has found that the tribromomethylalcohol was less toxic than any investigated except amyl hydrate. The slight toxicity is apparent when one observes how the animals, upon recovery from large doses, resume their ordinary activities and eat as though nothing had occurred.

LOCAL ACTION

A solution of the anæsthetic was without any apparent effect when placed in the conjunctiva, on the cornea, or in the gastro-intestinal tract, even when repeated a number of times.

RECTAL ANÆSTHESIA WITH TRIBROMOMETHYLALCOHOL

RESPIRATION

In common with other anæsthetics the respiratory rate is slowed, but Straub ⁶¹ has found that the respiratory efficiency is maintained by an increase in the depth of breathing. During anæsthesia an increase in the rate could be effected by the use of such stimulants as carbon dioxide, lobeline, and caffeine, as has been shown in man by Killian ²⁶

CARDIOVASCULAR SYSTEM

During anæsthesia with tribromomethylalcohol there occurs a drop in the systolic pressure that varies from ten to thirty millimetres mercury. We have been unable to personally observe any fall greater than ten millimetres mercury. This fall is found only in the early part of the anæsthetic and there is a return to normal systolic pressure during the remainder of the anæsthetic. The diastolic pressure has a tendency to remain constant. The pulse rate may be slightly increased, rarely over 100, but the quality is unchanged and is the same as that observed before the induction of the anæsthesia. Unger and May ⁵⁷ have studied a number of cases with the electrocardiograph and were unable to find any changes attributable to the anæsthetic. Bender ² has found that the use of ephedrine may be successful in combating the preliminary fall of systolic pressure should conditions ever warrant it. In toxic doses the blood pressure falls rapidly and eventually circulatory collapse ensues.

PARENCHYMATOUS

Laboratory animals that were subjected to several anæsthesia with the drug day after day showed no injury to any organ. White rats with large doses of the anæsthetic repeated, so as to receive 100 inductions within seventeen weeks, showed no change in the parenchymatous organs. Indeed many of the animals became pregnant during the conduction of the investigations and gave birth to normal litters.

In addition one might add that the drug has been found in common with other narcotics to have a slight antipyretic effect. It has also been found to be antiseptic and was capable of killing staphylococci and colon bacilli in one minute when subjected to 3 per cent solution.

PREPARATION AND ADMINISTRATION

The drug is slowly dissolved in water at 40° C, so as to make a 3 per cent solution. Care must be taken to prevent the temperature from rising above that point as there is a likelihood of decomposing the drug with the formation of the highly toxic and irritating dibromomacetaldehyde which Eicholtz ⁹ has shown was able to produce marked inflammation of the bowel that might even progress to necrosis. The dose varies from 1 gram to 15 gram per kilo of body weight, with an increase to 18 in the case of children. It has been the practice in the Surgical Clinic to also reduce the dose in the presence of large abdominal tumors and ascites. In using the drug for obstetrical purposes Hornung ²⁴ advocates a dose varying from 0.5 to 0.6 gram per kilo body

weight, but the writer has no experience with the use of it in that field. As a rule a dose of 13 gram per kilo of body weight has given a good anæsthetic with pleasing surgical relaxation. In some instances an additional dose of 0.25 gram per kilo was given when a patient was poorly anæsthetized and did not relax properly. A few cases will require in addition to the above some ether inhalation and this has been the experience of others as well as at the Clinic. The anæsthetic will last about three hours and may be shortened by emptying the bowel and the use of cleansing enemas as is the practice after the termination of the operation. Florcken and Mues,¹³ of the Marien-Krankenhaus in Frankfort, report that 80 per cent of their cases evidenced good surgical anæsthesia when doses above 13 gram per kilo were used and the percentage decreased with a decrease in the dosage. In the cases in which 10 gram per kilo was used only 60 per cent showed a good anæsthesia. This has been our experience as well. Roith,¹³ in a series of 214 cases in which a dose of 12 gram per kilo was employed, obtained a perfect anæsthesia in 61 per cent, a fair anæsthesia in 31 per cent and a poor anæsthesia requiring supplementary ether in 8 per cent.

The method of administration as practiced in the Clinic is to give a preparatory enema the night before operation and on the day of operation to give 5 gram barbitol (veronal). Others advocate the use of pantopan or morphine one or two hours before operation. The room should be darkened and the patient left undisturbed. The solution of the proper amount of the drug dissolved in a concentration of 3 per cent in water is then introduced into the rectum by means of a rectal tube, this being performed slowly, the tube removed and the patient left in a quiet condition, until satisfactory anæsthesia and relaxation has occurred. This anæsthetic is indicated in practically every type of surgical procedure, but will probably find its greatest sphere of usefulness in surgery about the head and neck, in which great difficulty is encountered when using the orthodox inhalation anæsthesia. At the Clinic it has been employed in goitre surgery, thoracoplasty, breast resection, laminectomy, gastric surgery, appendectomies, hernias, amputations, with pleasing results. No unpleasant after effects were noted. No headache, no post-operative nausea or vomiting were evidenced. Post-operative lung complications as bronchitis and pneumonia were not seen. No ill effects attributable to the anæsthetic have occurred, in our experience. The post-operative care as far as the anæsthetic was concerned consisted of merely flushing out the lower bowel with several liters of water.

Roith⁴³ has reported on his experience with the anæsthesia in 214 cases. He obtained a good anæsthesia in 61 per cent, or 130 cases. About 31 per cent, or 67 cases, required a small amount of supplementary anæsthesia and in 8 per cent, or 17 cases, needed a large amount of additional inhalation ether. All types of surgical procedures are included in his report. Two cases evidenced rectal irritation as was shown by tenesmus and a few mucus stools, which he attributed to the improper overheating during the mixture of the solution. He believes that the anæsthetic is especially indicated in very ner-

vous and hysterical patients who are so easily terror-stricken when brought into the operating room. The horror of the operating room and the struggling during inhalation anæsthesia are obviated by the peaceful induction in the patient's own room. He relates the personal experience of a physician upon whom he operated for a large cervical carbuncle, in which the physician expressed his delight in the easy way that the narcosis was induced and the lack of pain during the operation and the pleasant post-operative recovery. He states that the anæsthetic is not contraindicated in diabetes or pulmonary tuberculosis. His oldest patient was eighty-six and the youngest six years of age.

Florcken and Mues¹³ report on their experience with the anæsthetic in 180 cases. They obtained a complete efficient surgical anæsthesia in 116 or 64 per cent of the cases. They call attention to the fact that the percentage of success closely follows the dosage of drug. With the use of 10 gram per kilo, but 50 per cent of the cases gave a perfect anæsthesia, with the use of 125 gram per kilo about 60 per cent perfect anæsthesias resulted, and with the use of 13 gram per kilo over 80 per cent of the cases underwent a perfect anæsthesia. The youngest case operated was a child two and one-half years of age and the oldest a man seventy-nine years of age. They do not believe that even severe icterus is a contraindication to this anæsthesia, as four cases of severe icterus, including one of acute yellow atrophy, were successfully operated upon under tribromethylalcohol narcosis. Only two cases evidenced symptoms of rectal irritation as tenesmus, mucus and blood in the stools, and they cleared up readily. The only post-operative bronchitides observed were in five cases, all of which had required supplementary ether inhalation. They conclude that while the anæsthetic is not an ideal anæsthetic and that there is a difficulty in judging the proper dose, it should be adopted because it brings a quiet patient into the operating room, one who has not had the critical period when undergoing an inhalation anæsthetic, one who awakes nicely without nausea, vomiting, or headache and is not liable to post-operative lung complications.

Hornung,²⁴ of the Universitat-Frauenklinik of Berlin, reports on his observations with tribromethylalcohol in the rôle of an obstetrical analgesic. Using a dose varying from 05 to 06 gram per kilo he found that in a series of 100 cases he obtained good results in seventy-four, in twenty-four instances the analgesia was only fair, and in the two remaining cases absolutely valueless. He notes that twenty-seven cases had atonic bleeding and some disturbances in the separation of the placenta. In no case was there any effect upon the child. He stresses the fact that the kidneys and the liver must be in good functional order and consequently believes that its use in controlling the convulsions of eclampsia is contraindicated. The uterine contractions were somewhat weaker, but they increased in frequency and the length of labor was not markedly affected. The analgesia was gratifying in the majority of cases.

Nehrkorn³⁰ used the anæsthetic in a series of 180 cases, of all types and in all ages. The youngest patient was an infant of two months and the oldest

was eighty-four years of age. No pulmonary complications were noted in the cases in which Avertin alone was used. In the cases that necessitated the additional use of ether there were five instances of pulmonary complications. Kidney complications were not observed. He has successfully used the drug in two children to obtain an X-ray. One of his cases evidenced rectal irritation by having blood and mucus in the stools on the day following the use of the anæsthetic. He is in decided favor of using the anæsthetic, being especially impressed in the ideal way in which the sleep is induced.

Goecke¹⁵ reports on his method of using tribromethylalcohol by rectal drop introduction. He introduces the solution by a drop method into the rectum, so regulating the flow that at first it is very rapid and then slowing the introduction as the amount introduced approaches a dose of 1 gram per kilo until a satisfactory anæsthesia is obtained. In this manner he has been able to obtain a good anæsthesia with doses of .08, .10, .12, .14, and .15 gram per kilo of body weight. The last dose was not exceeded in any case. He was well satisfied with the results in thirty cases in which it was tried and will report at a later period when he has been able to observe it in more instances.

Heynemann,²¹ Killian,²⁰ Conrad,⁷ and others have also reported on their experience with the rectal anæsthetic.

Hirsch²³ has used the anæsthetic as a supplement to gas, local and lumbar anæsthesia. Polano¹² warns one to be careful when supplementing this with a lumbar anæsthetic. Gossman¹⁶ is especially enthusiastic in its use in surgery about the head and neck. Unger⁵⁶ and Ruge⁴¹ think that it is especially indicated in complicated cases of lung cardiac pathology. Butzengeiger,⁶ Frund,⁵⁰ Giuing,¹⁷ Muhsan,⁵⁰ Nordmann,⁴¹ Plentz,⁵⁰ Pribram,⁵⁰ Schmieden,⁴⁸ Vorschütz,⁵⁰ all report on its usefulness in thyroid surgery. Amersbach,¹ Behren,²³ von Eichen,⁸ Kuthe,³¹ and Toller,⁵¹ have described its usefulness in otolaryngology. Roedeleus (?) reports on its success in urological surgery. Amersbach,¹ Butzengeiger,⁶ Drugg,⁶⁰ Gossmann,¹⁶ Peterman,⁵⁰ Unger,⁵⁶ and Wiechoski,⁵⁰ were unable to find any interference with hepatic function in its use. Borchardt,⁵ Kreuter,³⁰ and Nordmann,⁴¹ were unable to discern any ill effects upon the kidney. Numerous other European clinicians have reported upon the value of this anæsthetic and the bibliography appended below contains the reports of over 100,000 cases in which the anæsthetic was used without the report of a single fatality.

In conclusion it might be stated that while the last word upon tribromethylalcohol anæsthesia has not appeared, it approaches the ideal anæsthetic more closely than any other at our present command. It has its drawbacks, namely, its labile chemical constitution that admits of its decomposition with the production of the highly irritant dibromacetaldehyde, and its rapid absorption from the intestinal tract that may permit the flooding of the patient with a toxic dose that cannot be removed. These disadvantages can be obviated by care in the administration of a properly calculated dose with close attention to its preparation—in not overheating the solution. Its advantages are manifold. The peaceful induction in the patient's own room, the ease with which

surgical procedures about the head and neck may be carried out without the embarrassment caused by the administration of an inhalation anæsthetic, the restful post-operative awakening without nausea, vomiting, headache or depression, the lack of pulmonary or cardiac complications. These are admirable characteristics that more than offset the disadvantages enumerated above.

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THE INCIDENCE OF HYPOACIDITY IN CHOLELITHIASIS AND CHOLECYSTITIS

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THE fact that the contents of the duodenum influence the amount of secretion of gastric juice has already been shown by Pawlow, Bickel, Cohnheim (1909-1910), and Sato (1914). Therefore, there is no doubt that in diseases such as cholelithiasis, which may lead to changes in the bile, there may also be produced changes in the duodenal contents and the latter, in turn, may influence the gastric secretion. Clinically, it has long been shown by our predecessors that patients suffering from cholelithiasis and those undergoing cholecystectomy often complained of gastric disturbances.

Concerning the gastric secretion in cases of cholelithiasis and cholecystitis much clinical and experimental investigation has been done, especially upon the question of hypoacidity. Hohlweg and Schmidt (1910) have noticed that most of the patients who had undergone a cholecystectomy or who suffered from cholelithiasis, presented either hypoacidity or anacidity. They sought to explain this condition on the basis of a dysfunction following the extirpation of the gall-bladder or a functional disturbance of the gall-bladder due to cholelithiasis. Hohlweg (1912) and Rost (1913) showed this to be the case in experimental animals and Rohde (1920), Behm (1921), Rydgaard (1921), and Dangshaft (1923) confirmed their findings.

However, Magnus (1913), Miyake (1913), Boss (1923), and others maintained that there was no connection between hypoacidity and anacidity on the one hand, and atrophy or failure of the gall-bladder or occlusion of the cystic duct on the other. To be sure, Toida found hypoacidity or anacidity in seventy out of eighty-two cases of cholelithiasis, but from his clinical and experimental investigation, he differed from Hohlweg in that he felt that there is no relation between the two conditions, because in cholelithiasis the repeated inflammation causes a disturbance of the bile secretion and this reflexly influences the gastric mucosa and, hence, the amount of hydrochloric acid secreted. Boss also stated that although he found a hypoacidity or anacidity in half of the cases of cholelithiasis, still it might be erroneous to consider it due to the extirpation of the gall-bladder.

We will not here vouch for the relation of hypoacidity and anacidity to functional disturbance or extirpation of the gall-bladder. Where the basis for the hypoacidity is not to be found, it exists, according to the assertions of the above-mentioned authors, as a fact in cholelithiasis or cholecystitis, and it remains as an irremissible clinical factor in the diagnosis of such

disease Behm especially has shown this to be the case in the differential diagnosis of chronic cholelithiasis and peptic ulcer, which give similar symptoms The degree of acidity after cholecystectomy is an important therapeutic guide and should always be determined post-operatively For this reason we have determined the gastric acidity pre-operatively in the following cases twenty-four with stones in the common duct, twenty-four of cholecystitis with or without stones, two of tumor of the liver, one of carcinoma of the gall-bladder, one of abscess of the liver

There were also twenty-two cases nine with common duct stone, and thirteen with cholecystitis, in which the gastric acidity was determined both before and after the operation The results are given in Tables I and II which give also the age and sex of the patient, degree of inflammation and the bacteria found in the gall-bladder

If one considers a free hydrochloric acid of fifteen to thirty as normal, and over thirty as hyperacidity and under fifteen as hypoacidity, then from the two tables one will group these forty-nine cases as follows twenty-five with anacidity, thirteen with hypoacidity nine normal, two with hyperacidity

This gives 77 per cent of hypoacidity or anacidity and compares with the results of others as follows Boss, 56 per cent, 1913, Miyake, 69 per cent, 1913, Ohly, 68 per cent, 1913-1915, Wohl, 46 per cent, 1917, Wessel, 54 per cent, 1919, Fenger, 45 per cent, 1919, Matsuo and Sawada 60 per cent, 1923

These authors stated that cholelithiasis and cholecystitis usually were followed by hypoacidity and anacidity In order to judge the assertions of hypoacidity and anacidity made by Hohlweg and others, we will analyze our results In the forty-one cases the condition of the cystic duct was determined at operation and in fourteen of these, minor changes were found about the duct, in nine there was thickening and marked stenosis, in fifteen there was mild stenosis, and in three cases there was complete occlusion The degree of hypoacidity did not correspond with the degree of change in the cystic duct as has been stated by Hohlweg and Schmidt Cases No 23 and No 28, in which a scarred atrophy of the gall-bladder was found with a thickening and marked stenosis of the cystic duct, showed normal acidity Case No 22 showed hypoacidity, although mild in degree when compared with the marked hypoacidity and anacidity found in cases No 18, No 26, No 32, and No 53, in which the pathological changes in the gall-bladder and cystic duct were mild Two cases, No 12 and No 49, in which the atrophy of the gall-bladder and sclerosis and stenosis of the cystic duct were so marked that there was probably complete dysfunction, showed normal acidity In case No 36 wherein the gall-bladder contents were a milky white in color and the cystic duct was completely closed, there was still free hydrochloric acid in the stomach In cases No 15, No 29, and No 35 where there was acidity, two, No 29 and No 35, showed a mild stenosis of the cystic duct and in No 15 the stenosis was marked Case No 52 showed occlusion

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TABLE I

Findings in Gastric Acidity in Twenty-four Cases of Cholelithiasis

Case No	Age Sex	Pre-operative		Post-operative		Degree of Obstruction		Bacteria in Bile
		Total Acid	Free Acid	Total Acid	Free Acid	Common Duct	Cystic Duct	
1	60 M	20	10					
5	30 F	36	23					
19	25 F	2	0					
43	71 M	1	0					
58	63 M	20	14					
4	46 F	38	25			Marked	Dilated	Bac coli comm Staphylococcus
10	41 M	2	0			Marked	Vague	Bac coli comm
15	45 F	0	0			Marked (by stone)	Marked scarred stenosis	Bac coli comm Bac lactis Staph aureus
21	46 F	24	12			Marked (by stone)	Marked scarred stenosis	Bac coli comm
26	47 F	5	0			Marked (by stone)	Mild	Bac coli comm
29	40 M	0	0			Marked (by stone)	Mild	Bac coli comm Staphylococcus
35	45 M	0	0			Marked (by stone)	Marked stenosis	Bac coli comm Staph Strep
36	59 M	9	5			Complete (by scar)	Complete	Bac coli comm Gall bladder sterile
51	67 M	8	6			Marked (by stone)	Open	Bac coli comm Bac lactis Staphylococcus
52	51 M	67	50			Almost complete	Open	Bac coli comm Bac lactis Strep
11	46 F	10	0	10	0	Mild	Open	Bac coli comm
16	50 F	8	0	3	0	Marked	Mild	Bac coli comm
18	49 M	2	0	0	0	Marked	Mild	Bac coli comm
22	35 F	28	10	16	0	Marked	Marked	Bac coli comm Staphylococcus
28	40 F	18	14	14	8	Mild	Open	Bac coli comm
30	41 M	10	0	0	0	Marked	Thickened dilated	Bac coli comm Bac lactis
31	39 M	8	6	0	0	Marked	Open	Bac coli comm Bac lactis Staph
47	48 F	37	13	13	10	Mild	Open	Bac coli comm Bac lactis
53	62 M	7	0	0	0	Mild	Open	Bac coli comm

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TABLE II

*Findings in Gastric Acidity in Twenty-four Cases of Cholecystitis, Two of Tumor of the Liver
One of Carcinoma of the Gall-bladder and One of Liver Abscess*

Case No	Age Sex	Pre operative		Post operative		Degree of Obstruction		Bacteria in Bile
		Total Acid	Free Acid	Total Acid	Free Acid	Common Duct	Cystic Duct	
13	74 M	2	0					
14	50 F							
27	61 F	6	0					
37	43 F	22	10					
12	27 F	26	20			Scarred thickening	Scarred stenosis	Bac coli comm
2	50 F	0	0			None	Mild	Bac coli comm
3	57 M	0	0			None	Mild	Bac coli comm
6	26 F	18	4			None	Mild	Bac coli comm
8	53 M	30	20			Dilated	Mild	Bac coli comm
9	18 M	44	32			None	Mild	Bac coli comm
20	32 M	7	3			Dilated	Marked	Sterile
45	20 F	4	0			Dilated	Marked	Sterile
50	33 M	16	8			None	None	Bac coli comm
55	44 M	20	18			None	None	Bac coli comm Staphylococcus
56	45 M	82	34			None	None	Bac coli comm Staphylococcus
7	34 F	2	0	2	0	None	Mild	Bac coli comm
32	41 F	6	5	6	2	None	Mild	
39	56 M	8	2	4	0	Dilated	Mild stenosis and thickening	Bac coli comm Staphylococcus
41	45 F	2	0	20	11	None	Mild	Sterile
48	38 M	30	0	2	0	Dilated	Mild	Sterile
57	54 F	26	0	26	15	Dilated	None	Bac coli comm Bac lactis
22	67 M	35	20	12	0	None	Marked	Bac coli comm
38	44 M	29	24	46	22	Dilated	Marked	Bac coli comm
46	29 M	18	7	35	20	Thickened	Moderate	Bac coli comm Bac lactis Streptococcus

HYPOACIDITY IN CHOLELITHIASIS AND CHOLECYSTITIS

TABLE II—*Continued*

Case No	Age Sex	Pre-operative		Post-operative		Degree of Obstruction		Bacteria in Bile
		Total Acid	Free Acid	Total Acid	Free Acid	Common Duct	Cystic Duct	
54	50 M	9	7	0	0	Thickened	Mild	Bac coli comm Diplococcus Streptococcus
49	52 M	24	4	4	0	Dilated	Almost complete	Bac coli comm
60	44 F	3	0	32	16	Dilated	None	Bac coli comm
63	42 F	14	8	6	3	Dilated	Marked (kinked)	Bac coli comm

of the common duct with marked atrophy of the gall-bladder which was continuous with a biliary fistula, yet in this case there was hyperacidity

The above facts do not agree with those of Hohlweg and others. The interference with passage through the common duct, due to stone formation, regardless of whether or not there is stenosis of the cystic duct, limits in greater or lesser degree the gall-bladder function. According to our investigation, the function of the gall-bladder becomes disturbed due to inflammation, whether or not there is stone formation or stenosis, and one must also recognize the fact that the gall-bladder mucosa heals with difficulty once it has become inflamed, so that the gall-bladder function in cases of cholelithiasis is practically always greatly impaired or destroyed. Therefore, when the findings in gastric acidity vary so, as described above, then it is impossible to explain them only on the basis of functional disturbance of the gall-bladder.

When one considers the relation between hypoacidity in this biliary disease and the sex of the patient one finds, according to Rydgaard, 73 per cent in men, 42 per cent in women. Hypoacidity, then, is found more in men than in women, but according to Dangschaft, there is 50 per cent in men and 76 per cent in women. Our results are as follows. In twenty-seven male patients there were three with normal acidity, seven with hypoacidity, and twelve with anacidity. Thus giving a percentage of 81.5 of hypoacidity or anacidity in men as against 86.3 per cent in women. From which one may see that the percentage is higher than that referred to above and that there is no appreciable difference between the sexes as regards the changes in gastric acidity.

In regard to age, as seen in the second table, hypoacidity and anacidity are found in every decade, but more between the ages of thirty and fifty, however, it might be a coincidental finding that in our series of cases these ages predominate. In our material we can say that the frequency of hypoacidity and anacidity does not increase with age, that is, that there is no senile achylia, but a definite relation to cholelithiasis. In short, it is unlikely to

determine any relationship between hypoacidity or anacidity and sex or age in the patients

Age

Gastric Acidity	Up to 20	21 to 30	31 to 40	41 to 50	51 to 60	More than 60
Hyperacidity	1	0	0	0	1	0
Normal Acidity	0	2	0	3	1	1
Hypoacidity	0	2	4	6	4	2
Anacidity	1	0	3	11	2	3

Within the limits of thirty to fifty, the sex difference was not perceptibly great, being only slightly greater in women. These findings correspond to the fact that cholelithiasis occurs more often in women than in men and is much more frequent between the ages of thirty and fifty.

In the investigation of the functional changes of the liver in cholelithiasis, which will be described later, we made bacteriological examinations of the bile which was withdrawn from the gall-bladder or the common duct at operation. These tests were carried out on forty cases. In four of these, the cultures were negative (cases Nos. 20, 41, 45 and 48). The others showed simple infections with bacterium coli or mixed infections of diplococci, staphylococci, streptococci, or of bacillus lactis acidii with bacterium coli.

In cholelithiasis there is almost always infection of the bile with bacterium coli, as has already been shown by Miyake (1913), Yokota (1926), Fuld (1927), and others. In our cases, the degree of hypoacidity paralleled the degree of infection. The five exceptions to this were the three cases (No. 41, No. 45, and No. 48) which showed no infection and anacidity, and one case (No. 20) which showed hypoacidity and no infection, and a fifth case (No. 52) which showed hyperacidity and a very low grade infection. The degree of infection, however, seems to have no relation as to whether it is a single or a mixed type of bile infection. Correspondingly, in the cases of anacidity the degree of infection is usually most marked. Hypoacidity or anacidity associated with stone in the common duct, which nearly always showed a high degree of bile infection, was usually more marked than the hypoacidity found in cholecystitis.

In investigations done on bile removed from apparently healthy gall-bladders at autopsy by Fiaenkel and Krause, Williams and Windsor, and Kirose, bacteria were often found. Opposed to this are the fifteen cases reported by Mieczkowski (1900) and the thirty-five cases of Toida (1920) and our five cases in which the bile removed during a laparotomy for some other condition, was found to be sterile. The assertion of van der Reis that bacterium coli communis, (Gram-negative) which is found in abundance in the colon, shows a tendency gradually to disappear in the upper small intestine where non-pathogenic bacteria, (Gram positive) the so-called enterococci, are found in profusion and that not infrequently the upper part of the

HYPOACIDITY IN CHOLELITHIASIS AND CHOLECYSTITIS

duodenum has been found free of bacilli, has lately been corroborated by Bitter and Loehi, following investigations of many patients suffering with diseases of the stomach and duodenum. They went still further and asserted on the basis of different clinical observations that the reason for this lay in the acid secretion of the stomach. According to them, the gastric acidity has an antiseptic influence upon the first part of the small intestine as well as the stomach and, to be sure, the pathogenic bacilli coming down through the œsophagus, are destroyed by the bacteria coming up from the lower gastro-intestinal tract. If, therefore, the stomach acid possesses its usual properties, the stomach and first part of the small intestine become poor in bacteria and especially free from bacterium coli. When, on the other hand, hypoacidity or anacidity is found, conditions are very favorable for the entrance of bacteria from the lower gastro-intestinal tract up into the stomach.

As we have shown above, in cholelithiasis there is nearly always hypoacidity or anacidity and there is also bacillary infection, especially with bacterium coli, the degree of which depends upon the degree of hypoacidity. Bitter and Loehr state that the bacteria enter the stomach from the intestine mainly due to the hypoacidity and anacidity. There is, however, the prevalent view that the cholelithiasis is the primary condition, that the hypoacidity is secondary, because in cholelithiasis the hypoacidity and anacidity accompany the bacterial infection. The basis for this view is in the post-operative results and in animal experimentation, wherein it is found that hypoacidity and anacidity appear after cholecystectomy. Others claim that this drop in gastric acidity does not obtain following operation. Of the patients operated upon by us for cholelithiasis or cholecystitis, twenty-two were afterwards examined, of whom thirteen had anacidity, five had hypoacidity and four showed normal acidity. If these results are compared with those obtained before operation, wherein ten had anacidity, ten hypoacidity, and two normal acidity, one sees that following operation hypoacidity or anacidity is more frequent.

	<i>After Operation</i>
Anacidity before operation, 10-cases	7 cases had anacidity 1 case had hypoacidity 2 cases had normal acidity
Hypoacidity before operation, 10-cases	5 cases had anacidity 4 cases had hypoacidity 1 case had normal acidity
Normal acidity before operation, 2 cases	1 case had anacidity 1 case had normal acidity

Referring again to Table I, seven out of thirteen cases showed anacidity before operation, one case was normal, and the other five showed hypoacidity. In these last five cases (22, 31, 39, 49, 54) the anacidity before operation was significantly low and after operation there was an absence of acid. In the two cases, numbers 28 and 48, where the pre-operative hypoacidity was not marked and, hence, approached a normal acidity, there was

after operation, only a slight drop, 8 or 10 degrees. Patient No. 38 had normal acidity before and after operation. Three cases, numbers 41, 57 and 60, which showed anacidity before operation and another case (46) of pre-operative hypoacidity, showed an increased post-operative acid secretion which returned to hypoacidity or normal acidity. Only one case, number 23, changed from a normal acidity before operation to anacidity after operation. In addition to this we have noticed that one patient, number 22, who had anacidity before and after operation, three years later showed a normal gastric acidity. According to the assertion of Toida there were ten of his cases who showed an increased acid content post-operatively and five cases in whom the acidity decreased. Matsuo in nine cholecystectomies showed five patients with post-operative increase and four cases with post-operative decrease in acidity.

Aldor, Ohly, Toida, and others attempted to explain this hypoacidity on the basis of a chronic gastritis. Although differing in some respects they agree essentially that chronic gastritis accompanies cholelithiasis, but we do not know how they interpret the relation between the bacteria and the cholelithiasis. We believe that hypoacidity and anacidity in cholelithiasis is brought about by some condition which may exist before the patient is actually ill, in which condition the bacteria easily enter the duodenum and stomach, whence they infect the bile passages. When cholecystitis and cholelithiasis are finally brought about by these infections, the hypoacidity is increased by factors which influence gastric secretions, such as fever, chills, vomiting, etc. Following this the penetration by the bacteria is facilitated and gastritis chronica anacida follows. From our clinical observations of patients with cholelithiasis we have noticed in a very careful history that long before the actual illness, the patient complained of symptoms of chronic gastritis, therefore, we believe that the factors such as hypoacidity, anacidity, bacterial infection and cholelithiasis are in direct relation to one another, that they affect the gastric mucosa and in this way aggravate the clinical condition. Hence, in this disease the estimation of gastric acidity should take its place with the other methods of clinical examination.

CONCLUSIONS

- 1 In cholelithiasis or cholecystitis there is nearly always hypoacidity or anacidity. In our cases the percentage of hypoacidity was 77. With a stone in the common duct the acidity is lower than in cholecystitis and there is more anacidity than in the latter condition.

- 2 From the post-operative results in our cases we cannot see that hypoacidity or anacidity has any direct relation to the changes in the gall-bladder or cystic duct or any disturbance in their function, especially after operation there is no significant change, wherein we cannot agree with the assertions of Hohlweg and Schmidt.

- 3 The gastric acidity in cholelithiasis seems to be the result of bacterial infection of the bile. We believe that the decrease in acid was present

before the occurrence of gall-stones and so favored the ascent of the bacteria up the intestinal canal giving opportunity for biliary duct infection. As soon as this infection accompanied the cholecystitis and cholelithiasis there was a further deficiency in acid, due to such factors as fever, chills, vomiting, etc., which influence the gastric secretion, which increased in severity and finally led to gastritis chronica anacida. Therefore, we cannot agree with the assertion that cholelithiasis is primary and the hypoacidity or anacidity secondary. We hold to the view that after the inception of cholecystitis and cholelithiasis, hypoacidity or anacidity and bacterial infection, which stand in close relation to the two above mentioned conditions, favor the progress of these diseases.

4 The measurement of gastric acidity in cholecystitis and cholelithiasis is an important diagnostic method and also serves as a means for judging the extent of the disease.

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SURGERY IN BREAST TUMORS, PROBLEMS CONCERNING DIAGNOSIS AND TREATMENT *

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THIS subject was selected for the Annual Oration because many of the Fellows of the Philadelphia Academy of Surgery have done much to increase our knowledge improve our technic and enhance the results in breast surgery. In fact every member except those who are directing their efforts to keep us on our feet, those who endeavor to clear our minds and stabilize our bodies, those who remove obstruction from our excretory channels and, at least one, who keeps our jaws in motion, are interested in, but discouraged with, surgery in malignant breast tumors. It was expected that by collecting a fairly large group of cases of "tumors" of the breast from two well-established hospitals something could be learned that would be of assistance in making early and correct diagnoses and secure better results. Follow-up systems in these institutions have not been established sufficiently long to be of material value. The records also leave much to be desired. The operations were done by thirty-five surgeons, and many of the patients were private which may account for the omission of some desirable information in the hospital histories.

The laboratory work, with the exception of a few brief intervals, was done by excellent men. Opinions on tissue diagnosis were often obtained from other sources. Not infrequently the pathologists did not agree. Again, the same slides examined by different men in the same laboratory would differ in the diagnosis, or the report would be so worded that a surgeon with a moderate knowledge of pathological histology might suspect totally different tumors.

In May of 1924, the writer¹² operated upon a woman for simultaneous bilateral mammary cancer. The patient was presented February 10, 1926, at a joint meeting with the New York Surgical Society, an account of which appeared under the Transactions of the Academy of Surgery, May 1926. The breasts were removed by the Stewart technic at a twelve-day interval. One was examined by the director of the hospital laboratory, the other by an assistant. There was sufficient dissimilarity in the reports to make one suspect unlike carcinomas, whereupon the director was requested to examine both specimens. He reported them as being identical, both adenocarcinoma suggestive of duct origin. The axillary nodes were not involved. She wrote that she was in splendid health on May 2, 1929.

Quoting from Bland-Sutton²⁶ "the breast is so open to observation that

* Annual address for 1928 before the Philadelphia Academy of Surgery delivered May 7, 1929.

it is the organ from which the knowledge of the natural history of cancer was primarily derived" In regard to this Rindfleisch pertinently remarks "The tumors of the female mammary gland have been so often, and already at so early a period, the subject of earnest histological investigation, that in this we might not improperly call the mammary gland the nurse of pathological histology" One would think that the pathology of the breast could be so simplified that errors in histological diagnosis should not occur We owe much to McFarland¹⁵ who has endeavored to remove the haze from the nomenclature of some of the benign breast tumors In an effort to study the more common fibro-epithelial tumors, to observe the differences between adenofibromata and fibro-adenomata he assembled from five large hospitals about 300 tissues that had been indexed under thirty-three different names Some of these were not tumors at all To read his conclusions will stimulate one to read his paper

"1 Two hundred and eighty-nine cases, supposed to be benign fibro-epithelial tumors of the female breast, were studied clinically and pathologically, for the purpose of harmonizing and simplifying the nomenclature

"2 One hundred and five of them, described under no less than thirty-three different names, were found to be periductal fibromata

"3 One hundred and forty-seven, described under much the same names, showed no histological indication of being tumors, or in any way related to them, but were simply mammary gland tissue, either normal, or in some condition of involution

"4 A system of nomenclature that permits tumors and non-tumors to be given the same names is too faulty to be continued

"5 As all of the tumors resolved themselves into varieties of a single well-characterized genus, it would be well to call them all by the same name, and that recommended as most appropriate is Warren's choice, periductal fibroma

"6 In all but seven cases there was no difficulty in separating the tumors from the non-tumors

"7 The research having been conducted upon material collected from five large, first-class hospitals, where it had been studied by many different pathologists, may be regarded as fairly representative of pathological tissue work as commonly conducted in hospitals

"8 The mistake of calling non-tumor tissues by names belonging to tumors, may have been the result of overzealousness on the part of the pathologists to cooperate amicably with the surgeons

"9 There are anatomical and physiological mammary disturbances of the breast that may occasion 'lumps' that have no relation to tumors, and the surgeons should be informed and not led to believe that they have removed tumors when none existed

"10 Pathology must remain confused both in theory and application unless its terminology be so relieved of ambiguity as to be easily understood"

It has been clearly demonstrated by Cheatle,³ Fraser,⁷ Wainwright,¹⁶

and others, that sections cut from the whole breast are less likely to lead to error in diagnosis than if a small section of the tumor be examined. Sectioning whole breasts undoubtedly will aid pathologists to correct former and present misconceptions as to benign and malignant lesions. Several recent papers by Cheatle³ definitely indicate the term "chronic mastitis" a misnomer. He states that nodularity and lumpiness often palpated anteriorly in breasts of women between the ages of thirty and forty-five, and especially after lactation, being due to the thickening of the ligamenta suspensoria of Sir Astley Cooper which are attached to the skin. The branches contain lobules of fat. If the skin is undercut the cutaneous attachments divided the nodularity will disappear. Unfortunately an early carcinoma may be masked by this condition.

Nearly all papers dealing with carcinoma of the breast stress early diagnosis. Teachers of surgery and textbooks on surgery must inform students and doctors how a diagnosis of early malignancy is made, if it can be done. When the roentgenologist fails to detect an early lesion of the stomach or bowel, and he often does, the surgeon will criticize him. Finally, when the patient vomits blood or has an obstruction there may be a re-check and the surgeon will blame the roentgenologist for losing an operable, and perhaps a curable, case. The surgeon cannot lean on the X-ray department to diagnose a breast tumor. Textbooks contain photographs of carcinoma of the breast, showing the tumor which may be so large as to deform the gland, with retracted nipple, skin involvement, axillary node involvement and statistics showing far and wide metastases. All of this is necessary and impressive. However, we should exert ourselves more to recognize the disease before it has reached the stage when chance for cure has been decidedly diminished.

Most carcinomas are discovered inadvertently by finding a lump. There are other symptoms which should be observed by all persons. At puberty and often at the menstrual period there may be pain or discomfort. Lancinating pain at one point which appears at irrelative times or differs in character from previous pain or discomfort is looked upon by Cheatle⁶ as suspicious of carcinoma. The earliest case of carcinoma of the breast he operated upon had no other symptoms, there was no demonstrable lump, microscopy revealed a focus of carcinoma which had begun to invade the surrounding fat. A discharge of blood or serum should also be looked upon with suspicion. Localized nodularity, or a definite hard lump in the gland, probably will continue to be our chief diagnostic symptom.

Carcinoma mastitoides, or carcinoma of the lactating breast, very likely is the most malignant, fortunately infrequent, tumor of the breast. The majority of these tumors are diagnosed abscess. A professor, not of surgery but one who operated when the opportunity presented itself, made four long radiating incisions, practically cutting the breast into quarters, for carcinoma mastitoides in late pregnancy. The woman did not live to see her child born. General practitioners and obstetricians particularly should keep the picture

of this lesion in mind. Inflammatory carcinoma of the breast reported by Burton J. Lee¹⁴ and Tannebaum probably differs from lactation carcinoma. In a list of twenty-eight cases, fourteen had never lactated. The clinical phenomena are similar. None of these cases occurred during pregnancy or lactation. To diagnose carcinoma mastitoides we quote from a previous paper: "The¹¹ disease is seen during the childbearing period (sometimes in the latter months of pregnancy, but more often in the early months of nursing), prior to forty years of age, and at the height of physiological activity. It begins as a localized area of induration, which extends rapidly and soon involves the entire breast. The localized 'stony-hard' nodule is conspicuously absent. The skin early assumes a dusky red or purplish-red color. It becomes brawny, feels hot, of the 'pigskin' variety, is fairly well margined, and appears to be attached to the underlying structures. The previously pendulous breast is firm, increases rapidly in size, and projects like that of a virgin. Pain is not so severe as one would suppose from the appearance of the breast. There is no fluctuation, and but moderate tenderness. The nipple shows no retraction in early stages. The axillary glands may or may not be palpable. The involved skin not infrequently extends well beyond the breast, and the other breast may become involved early. In fact, several cases of simultaneous invasion have been reported."

"The onset in suppurative mastitis is acute, pain often is intense, and tenderness is marked. The skin is bright red and becomes dusky as inflammation progresses. It is never brawny, and fluctuation usually can be determined. There is definite elevation in temperature and leucocytosis. The differential count nearly always shows an increase in the polynuclear cells. In carcinoma, the temperature is normal or slightly elevated. The leucocytes may be slightly increased, and the differential count frequently shows an increase in the mononuclear cells. The diagnosis should be made without section for histological study as has been suggested."

In a paper recommending exploratory incisions in cancer of the breast Fitzwilliams⁷ says this about early cancer of the breast: "There is not a single sign of malignancy and nothing even to bring malignancy to mind. There is an indefinite something and undefined thickening. Diagnosed in this stage is the only time we can almost guarantee a cure to a patient." Anything having the characteristics of malignancy he does not consider as early carcinoma. All the signs and symptoms of cancer of the breast are due to extension of growth. This must occur.

From published statistics it is estimated that 80 per cent of breast tumors are malignant, 20 per cent are innocent. If one compares recent statistics with those of the past twenty-five years it will be noted that the number of innocent tumors coming to operation have increased in ratio with the malignant tumors. Gibbon's⁹ analysis of his last two hundred cases showed that 45 per cent were benign. Approximately 38 per cent of the cases collected from the records at the Pennsylvania Hospital since 1901 were benign, and 46 per cent of those from the Jefferson Hospital since June, 1920. The latter

corresponding with Gibbon's cases. Apparently more attention has been given in recent years to benign growths. If this is true an occasional early carcinoma should be found. We can no longer say that the chances of a breast tumor being malignant are three to one.

Exploratory submammary incision with excision of the suspected tumor should be done in all doubtful cases. This can be accomplished satisfactorily and safely with the endotherm knife. The writer has had no experience with frozen section reports. He prefers to rely on macroscopic evidence. Should there still be uncertainty about the diagnosis the wound can be closed in the proper manner and wait for a fixed specimen report. Seldom will the operator have his opinion reversed by the pathologist.

Attempts have been made to grade the degree of malignancy in carcinoma, histologically by Bionders, Giczenough and others, and clinically by Lee¹³ and Stubenbord. Histological grading is of no value to the surgeon before or during the operation. Lee and Stubenbord use the age, lactation rate of growth and extent of disease as weighting factors, subdividing each factor into gradation factors, apparently with a considerable degree of accuracy. All surgeons have considered the weighting factors without any mathematical values. One should add obesity and heritage. There is sufficient evidence that a person with a bad familial history of carcinoma must oftentimes be placed in the group of bad prognosis. The fact remains that a benign growth requires excision and a malignant growth the most thorough operation the surgeon is capable of performing.

There are numerous well-standardized operations for amputation of the breast. A surgeon should do the operation he likes best if it permits of wide excision of fascia as advocated by Handly. We believe in removal of the pectorals with few exceptions. The transverse elliptical incision of Stewart has met our requirements in all but two cases. A recent case—a large fibroma in the upper hemisphere, regarded clinically as a fibrosarcoma. The other a large, slow-growing, fixed carcinoma extending high toward the shoulder. In both of these the incision was oblique extending toward the axilla. It has been our custom to undermine the lower flap well over the rectus abdominalis, incise the fascia and dissect it upward toward the breast. Then the upper flap is reflected, and the axilla cleaned out. It is desirable to have an X-ray of the chest before operating for malignancy.

Pre-operative X-ray treatment according to Wood has little to recommend it. Experiments in animals have shown that the lymphatics cannot, but terminal arterioles can, be closed by the X-ray. Therefore, to use X-ray preliminary to operation on the assumption that it will make operation safer by closing the lymphatics is wrong if we believe in the spread of cancer by the permeation method. On the other hand, if we accept the embolic theory it may be of value. That metastasis does occur through emboli in the vascular system seems plausible. We have noticed infection more often where X-ray was employed pre-operatively.

Since the routine post-operative X-ray treatments there have been de-

SURGERY IN BREAST TUMORS

cidedly less local recurrences in our cases. Local recurrences seem to respond fairly well to the X-rays. We believe in excising these when it is feasible—in the absence of metastasis and a limited number of tumors.

Concerning reexcision of recurrent tumors it may be of interest to recall a case of S. D. Gross¹⁰ reported in his "System of Surgery" published in 1864. An unmarried woman, aged forty-four, had a partial excision of the left breast for a soft tumor in 1857. In 1859 she came under the care of Doctor Gross when he removed the entire breast. In September, 1861, he performed the twenty-third and last operation. Altogether fifty-four tumors were removed. Recurrences were at or near the former cicatrix, usually within a few weeks. The sixth tumor removed was examined microscopically by Doctor Packard and diagnosed encephaloid of the mamma. She was well three years after the last operation. We have on two occasions excised recurrent tumors.

Statistics are fallacious because of the discrepancies of histological reports and different methods used in assembling cases. Ashhurst¹ properly states that when a large clinic reports statistics on carcinoma a table should be used which is comparable to the scheme employed by Greenough and Simmons. Their five-year cures thus presented 1918-1920. This we consider a fair average. As stated before, we are not prepared to give a correct estimate of our five-year cures. Our personal records are also lacking in this respect. The private patients average 34 per cent of five-year cures. Ward patients fall far below this figure.

Greenough's statistics show marked improvement as time went on. Technic has been improved since 1894. Have the results been commensurate with the technic?

Let us compare the results of carcinoma of the colon of recent years with good technic for resection with those of carcinoma of the breast with good technic for radical amputation. It is obvious that the advance made in colon surgery has outshadowed the advance in breast surgery. Therefore, in order to obtain better end results it is evident that it cannot be accomplished by refined technic alone. The case records reviewed included the breast tumors at the Pennsylvania Hospital from 1901 to January, 1929. Very few were found prior to 1905. Approximately fifty cases concerning which there were either operating room records or laboratory reports, the histories could not be found. There were histories and laboratory reports of 450 tumors during that time of which 278 (62 per cent) were malignant, in thirty-four of these the treatment was not stated or the operation was not described. There were 172 (38 per cent) benign tumors.

The records at the Jefferson Hospital were collected from June, 1920, to January, 1929. There were 431 tumors, of these 234 (54 per cent) were malignant of which twenty-four were not operated upon, and in five the treatment was not described. There were 197 (46 per cent) benign tumors.

Total malignant tumors of both hospitals were 512, of these six were

sarcomas, a trifle more than 1 per cent. A recent textbook on surgery states that "sarcomas constitute about 10 per cent of the tumors of the mammary gland."

The records of 881 tumors were examined, of this number 114 were personal cases. The laboratory reports of all of the latter were reviewed. 50 per cent of these were malignant. The large proportion of the benign tumors of our personal cases we believe is due in a measure to the fact that nearly 70 per cent were private. The Jefferson Hospital has proportionately a much larger private service than the Pennsylvania Hospital which may in part account for the higher percentage of benign tumors. Furthermore, we did not include cases from the Jefferson Hospital prior to 1920. It would seem that patients with suspected breast tumors are more likely to apply for advice. However there is a fallacy to offset this somewhat. The average duration of malignant tumors in the cases at the Pennsylvania Hospital was 9.92 months, Jefferson Hospital 11.84 months.

It has been suggested by pathologists and surgeons that the pathological diagnosis of malignant tumors should be so worded that the surgeon and radiologist could recognize the type and virulency of the tumor. Certain types respond favorably to radiation.

In going over the pathological reports of our own cases it was interesting to note the description of these tumors. Those of vast experience would describe the specimen macroscopically and microscopically with accuracy and detail and frequently express an opinion whether or not it was very malignant, then simply put down the diagnosis "carcinoma." Often, however, no mention was made of the axillary glands. All specimens about which there was any doubt were sent to other pathologists for opinions. We believe that all of the pathological specimens were studied with interest and care and in very few cases would the diagnosis be changed if the slides were submitted to other pathologists. It would be highly desirable to have detailed description and uniform and simplified diagnoses.

That the pathologists should be supplied with more accurate data is obvious. MacFarland gave excellent reasons for careful notes.

Two cases, one not included in the cases reviewed, strongly suggest that "enucleation" of a supposedly benign tumor is insufficient. An able surgeon enucleated a benign tumor from a woman's breast forty-five years of age. A competent pathologist reported it as benign. Within twelve months there was a recurrence beneath the scar with metastasis. The breast tumor was excised for verification of the diagnosis. It was carcinoma.

The other case, a woman fifty years of age, had a fibroma excised and examined by a reliable pathologist who confirmed the diagnosis. Within six months there was a recurrence. Shortly the breast had the appearance of a rapidly-growing scirrhus. The first slides were examined by other pathologists and the diagnosis was confirmed. Following a radical amputation the tumor was examined which proved to be scirrhous carcinoma. These cases indicate that it is safer to excise the segment of the breast containing the

benign tumor The carcinomatous cells probably were close to the innocent growth

In two of our personal cases unnecessary radical amputation was done, one for diffuse cystic mastitis in which carcinoma was suspected, the other proved to be multiple fibromata which had been diagnosed clinically as fibrosarcoma The pathologist, a young man, had the specimens examined by one of wide experience who said there was no evidence of malignancy They both suggested that we follow the case carefully

On one occasion we erred by excising a growth believing it to be benign but on incision it appeared to be malignant The laboratory reported it scirrhous carcinoma The patient was operated upon for a mixed tumor of the parotid gland As she came to the operating room our attention was called to the breast



Fig 1—Multiple fibromata Diagnosed clinically as fibrosarcoma Radical operation May 11, 1928 Well July 15, 1928

tumor A hurried examination was made and it was thought to be a benign tumor The patient was told later that the tumor was malignant and amputation was advised She declined X-ray treatments were given There has been no recurrence in seven years Of the fifty-seven personal cases, fifteen were diagnosed pathologically mastitis Probably some of these were operated upon unnecessarily Again, several diagnosed clinically mastitis were reported cystadenoma

My thanks are due to the staffs of both hospitals for permitting us to examine the records, and especially to Dr Alan Parker who gathered the data

CONCLUSIONS

- 1 Recent records indicate that more benign breasts are operated upon than formerly This should lessen the incidence of carcinoma
- 2 Pathologists should endeavor to standardize and simplify the nomenclature of benign and malignant breast tumors Special training is desirable
- 3 Suspected benign tumors should not be enucleated but the section containing the tumor should be excised
- 4 Amputation of the breast leaves a bad deformity Let us reserve the operation for definite indications and then do it thoroughly

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TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY

STATED MEETING HELD APRIL 1, 1929

The President, DR ASTLEY P C ASHHURST, in the Chair
CALVIN M SMYTH, JR, M D, Recorder

MULTIPLE MYELOMA

DR J STEWART RODMAN reported the case history of a colored woman, thirty-three years of age, who was admitted November 1, 1928, into the reporter's service, at the Woman's College Hospital, with the chief complaint of pain in the hips, back and shoulders and a tumor about the size of an adult patella three inches below the left knee-joint on the anterior surface of the right tibia. Eight years before she struck the left leg, at the site of the present tumor, against a tree. No break of the skin and no fracture resulted but the leg was painful and a small hard nodule developed about one month later. It had never been painful but has continued to grow until it became about three times its original size when she was admitted to the hospital. For the past four years she had complained of the present symptoms. Due to pain she has been unable to walk without crutches for the past three months and when she does so there is now pain in the sternum, ribs and shoulder. She has had severe pain in the left thigh for the past three weeks and has been treated for rheumatism for a year.

The physical findings of importance were the presence of the tumor of the left leg three inches below the knee-joint. This tumor was about one and a half inches in length and one inch in width, slightly movable over the bone and apparently growing in the subcutaneous tissue. It was hard in consistency. There was enlargement of the inguinal glands on both sides. On the right, small nodular bodies extend subcutaneously down the inner side of the thigh to the inner side of the knee. There is tenderness on deep palpation on the inner side of the right thigh just below inguinal region. On the left side there is extreme tenderness just below Poupart's ligament and a second area of tenderness on the outer side at a little more distal level. There is pain at the left hip-joint on passive motion. On two occasions the blood Wassermann was reported as anticomplementary. The blood count was hæmoglobin 60 per cent, erythrocytes 4,044,000 leucocytes 4100. Blood chemistry showed calcium, CO₂ combining power, sugar, and urea to be within normal limits.

Icterus index 3.6 van der Berg negative direct. The urine was essentially negative.

On the X-ray diagnosis of probable multiple myeloma the urine was examined for Bence-Jones albumosuria and found positive. On November 16, 1928, the tumor of the left leg was removed under gas-oxygen anesthesia. It proved to be unattached to the bone and the pathological diagnosis was myxofibroma. The patient was discharged December 13, 1928, at her own request.

METASTASIS TO BONE FROM CARCINOMA OF BREAST

DR J STEWART RODMAN reported the case of a married woman fifty-five years of age who was admitted May 10 1928 into the reporter's service.

at the Woman's College Hospital. This patient had known of a tumor in her left breast for five years, at the beginning of which time she noticed a small red area in the outer upper quadrant. About one year ago, the mass having increased three or four times its original size, the skin broke down and it began to bleed. Still for some months she continued to treat herself until finally in April, 1928, she consulted Dr. George Pfahler. Since then she had had fourteen X-ray treatments. The bleeding stopped and the mass grew smaller in size. She was then referred to Doctor Rodman for operation.

The left breast presented an area, 5 by 2.5 centimetres, to the outer side of the nipple in the upper outer quadrant, the skin over which was ulcerated. There was a definite tumor mass beneath, which was not adherent to the chest wall. The axillary glands were palpable on the left side.

May 11, 1928, the breast was amputated with no other idea than the control of hemorrhage and the removal of the ulceration. Pathological examination diagnosed the mass adenocarcinoma.

March 14, 1929, about ten months after her first admission to the hospital she was readmitted for the purpose of X-ray study because she complained of a lump in the right clavicle and pain in back for five weeks. Since her operation she had gained weight and her general health was greatly improved for about seven months when she first noticed the lump above referred to in the right clavicle.

DR. JACOB VASTINE demonstrated a series of X-ray films illustrating various phases of the metastasis to bone from carcinoma of breast. The speaker also called attention to some of the results which had been obtained from the treatment of primary growths by intensive radiation. He laid particular emphasis on the fact that most cases which the roentgenologists were called upon to treat were already in an almost hopeless condition. Doctor Vastine was of the opinion that primary growths could be treated with practically the same degree of success by radiation as by surgery, if the roentgenologists had the opportunity of treating the favorable ones.

CHORDOTOMY FOR GASTRIC CRISES, COMPLICATED BY ACUTE INTESTINAL OBSTRUCTION

DR. HUBLEY R. OWEN and DR. TEMPLE FAY, by invitation, reported the following case which the reporters believe to be the first one reported in which an acute intestinal obstruction occurred in a case where section of the anterolateral columns (chordotomy) had been performed, rendering the patient anæsthetic to pain on the right half of the body below the nipple line. The signs and symptoms of intestinal obstruction in the presence of this anæsthesia were unusual. An exploratory laparotomy was possible on the right side without the need of anæsthesia, and an opportunity was afforded to observe the remaining distribution of pain fibres to the peritoneum, a fact of much importance, neurologically. The case also illustrates a new method of chordotomy whereby the selection of pain fibres within the cord itself, under local anæsthesia, is possible so as to permit the destruction of these fibres alone, leaving other forms of sensation intact.

Doctor OWEN established at the time of his operation, the fact that the parietal peritoneum on the right side was insensitive to pain. This corresponded to the area of the pain loss also noted in the skin and muscle layers. Doctor Owen found that traction or manipulation of the visceral peritoneum

was painful, indicating clearly that the pain fibres remained in the visceral peritoneum, and either had their origin from the left side or entered the visceral peritoneum from a level above the sixth thoracic segment of the cord on the right

The operation of chordotomy was suggested by Doctor Spiller in 1907 and was first carried out on the human being for him by Doctor Edward Martin, in 1911. Since that time it has been used frequently in this country and abroad as a means for relief of pain. The development of a safe and accurate technic for this procedure is due to Doctor Frazier, who reported a series of these cases with Doctor Spiller, in 1920. The method used by Doctor Frazier was the introduction of a small curved hook designed by him to include only the anterolateral columns of the spinal cord. This method has given extremely satisfactory results. Doctor Spiller has suggested a further refinement in technic, when indicating the possibility of separating the pain and temperature fibres within this anterolateral column by the introduction of a small knife to the desired depth, while the patient is under local anaesthesia, and the neurologist is present to determine the exact level of anaesthesia for pain or temperature required in the operative procedure.

It has been possible in two cases so far, to dissociate the pain and temperature fibres and to establish exactly the level of anaesthesia desired. The following case illustrates this method of chordotomy and the location of the fibres supplying the lower extremities and the trunk. A further addition to the understanding of pain distribution to the visceral peritoneum is due to the subsequent observations of Doctor Owen at the time of his operation for intestinal obstruction.

The patient was studied in the neurological service of Dr. Edward Strecker, at the Jefferson Hospital, where a diagnosis of tabes associated with gastric crisis was made. Later she was transferred to the Philadelphia General Hospital for continued treatment and observation, where she was under the charge of Dr. George Wilson who recommended section of the anterolateral columns for relief of the severe pains, associated with her crises. A bilateral chordotomy was performed at the fifth thoracic segment of the cord following which she was pain free for one month, until the sudden onset of the intestinal obstruction.

Present Illness—Two years before admission the patient began to complain of shooting pains in the sides and epigastrium which were bilateral, extending around to the back. Nausea and vomiting usually followed these attacks of pain. The pain always radiated around the body. There was belching of gas, abdominal distention, precordial distress, rapid respirations with marked palpitation. She complained of this pain for several months before she went to see a physician who advised an operation after examining her. She was operated at the Lankenau Hospital one year ago for gall-bladder disease and made an uneventful recovery but had recurrence of her former abdominal pains about three months after the operation. The attacks of pain have become more frequent recently, nausea and vomiting accompanying the attack. There was loss of appetite following these attacks, food did not bring on an attack but often made the pain worse during the period of her pain. She had lost twenty pounds which she ascribed to her inability to assimilate

food Her menses aggravated the attacks There was no reference of pain to the arms or groin at this time The pains of which she complained are similar to those which began five years ago, and were called rheumatic pains The attacks of pain have increased to such a degree that she spends most of her time in bed

She was a fairly well-nourished white female, who evidently was in severe distress and pain, as evidenced by her position and facies

Neurological examination showed marked diminution of the deep tendon reflexes throughout, with Argyll-Robertson pupils and ataxia

Gastro-intestinal X-ray—Ileitis and cæcitis of infectious origin No X-ray evidence of intra-abdominal malignancy Intra-abdominal adhesions, post-operative

The patient was diagnosed as having tabes with gastric crises In consultation with Doctor Gilpin it was decided to place her on treatment of spinal drainage and mercury byunction She had three drainages and made excellent progress, having had two attacks of epigastric pain up to November 18, 1928 On that date, she complained of pain in the same place No therapy seemed to be of benefit November 20 she became confused and very delirious, shouting and talking about committing suicide Although she was confined to a quiet room, she disturbed the entire ward It was decided therefore to transfer her to the Philadelphia General Hospital which was done December 3, 1928

Wassermann studies at the Philadelphia General Hospital showed a four plus spinal Wassermann Several blood Wassermanns were negative The patient was studied in the service of Dr George Wilson who concurred in the diagnosis of tabes with gastric crises, and because of the patient's severe and prolonged attacks of pain, advised section of the anterolateral columns on each side of the spinal cord as a means of relief of pain She was transferred to the service of Dr Temple Fay on January 21, 1929, and a bilateral chordotomy performed under local anaesthesia

The anterolateral columns were incised on the left side by means of a cataract knife The resultant sensory pain and temperature loss was demonstrated after each incision by careful neurological tests made by Doctors Spiller and Wilson, until the level for pain loss was demonstrated as high as the fourth thoracic segment on the right

Following the left-sided chordotomy there was some loss of motor power in the left leg The dentate ligament on the right was then incised, the cord rotated and chordotomy performed Anaesthesia was not demonstrated as high on this side, but only to the region of the hip On the right side of the body, anaesthesia was demonstrated approximately to the third dorsal segment

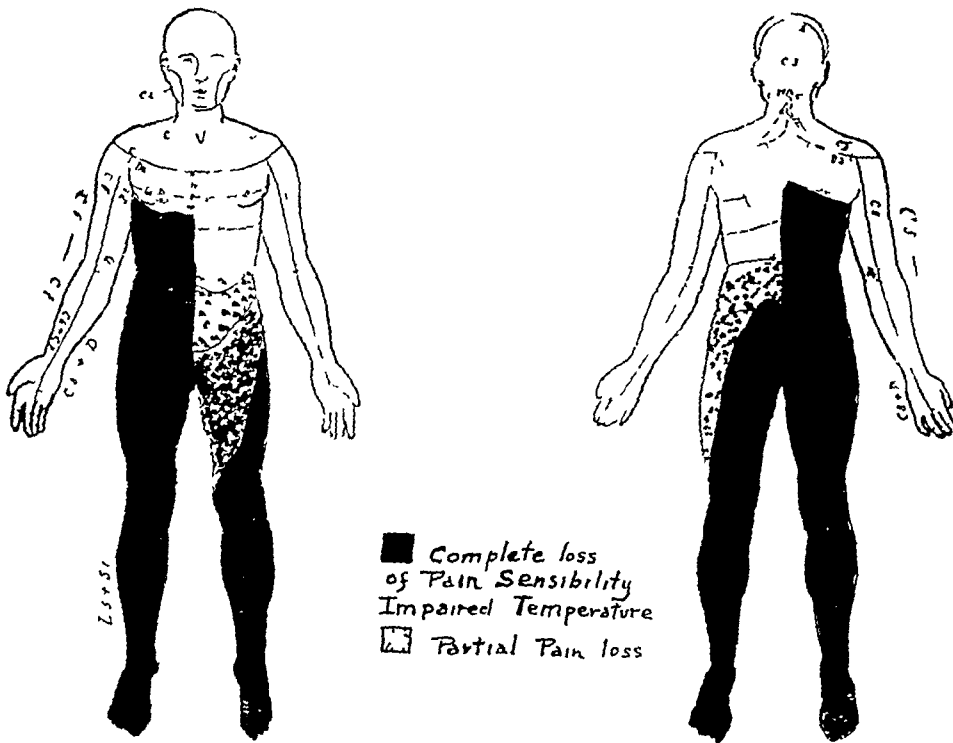
The patient had an uneventful post-operative convalescence excepting for some lighting up of an old cystitis She rapidly regained the power in her left lower extremity and anaesthesia was demonstrated for pain on the right side as high as the fifth thoracic segment, a diminution for temperature sense was present though this was not lost On the left side, the loss of pain extended as high as the second lumbar segment, with marked impairment of pain as high as the ninth thoracic segment Temperature sense was also impaired, but not lost in this area (Fig 1)

The case demonstrated that the pain fibres for the sacral region and lower extremities are situated on the periphery of the spinal cord Doctor Spiller's sensory examination disclosed that the area of anaesthesia rose on the body as the knife was introduced successively deeper into the cord in the region of the anterolateral columns The definite loss of pain without a similar degree of temperature loss indicates that these fibres are represented by separate pathways within the spinal cord, and that with great care, under local anaes-

CHORDOTOMY FOR GASTRIC CRISES

thetia, it might be possible to select the exact fibres desired and regulate the height of anæsthesia for pain required, in this operation. The former method was one in which under general anæsthesia the entire anterolateral column was enclosed within a hook and sectioned *en block*. The patient was pain free and had made a most satisfactory recovery until February 18, 1929, approximately one month after her chordotomy, when she was awakened by severe pain in the right pectoral region, which radiated down to the right elbow. The patient then vomited. Immediately following this she began to have abdominal pain located over the left side of the abdomen. She became dyspnoeic at the same time. Her abdominal pain gradually became intensified until it was excruciating in type and the patient cried out due to its severity. Lips and fingers were cyanotic. Pulse was almost imperceptible.

Lottie G.



Temple Fay.

FIG. 1

Blood pressure 80/70 in each arm. Temperature 98°, pulse 110. Soft second sound almost inaudible. Urine contained myriads of leucocytes. Because of the sudden onset, low blood pressure, cyanosis, abdominal and brachial pain, coronary thrombosis or angina pectoris was considered. The plus four Wassermann made the impression of coronary sclerosis more probable. Doctor McMillan secured an electrocardiogram and ruled out an acute cardiac lesion. An abdominal complication was then suspected and Doctor Owen was called in consultation. The lack of rigidity of the abdomen, the presence of a tender mass in the upper abdominal area, with extreme pain, temperature 101, pulse 150, respirations 48, with incessant vomiting, not faecal in character, presented a problem for diagnosis. The abdomen was not distended, but on viewing the patient's abdomen from the foot of the bed, it could be seen that on the right side in the middle of the abdomen, there was a globular swelling. Palpation elicited some pain and tenderness, but neither the pain nor tenderness was acute in character. The mass was doughy in consistency, there was no rigidity or distention of the abdomen. The rectal examination was negative.

The diagnosis of intestinal obstruction was made and the patient was operated upon immediately by Doctor Owen. Incision was made to the right of the mid-line without the need of an anæsthetic. On opening the peritoneum, considerable blood-stained fluid was found in the free peritoneal cavity and immediately there presented itself a large obstructed coil of intestines. This large loop of small intestine, estimated between eight and ten feet was found tightly bound by a band of adhesions around the mesentery, and the whole loop of gut was twisted on itself by torsion. The torsion was corrected and the thick band of adhesions was cut between two ligatures. The constricted area was well back in the mesentery, but the wall of the bowel was glistening and was brownish in color. No area of actual gangrene nor necrosis was found. Hot towels were applied and the color of the intestines was partially restored. The area of involved intestines was too great and the patient's condition too grave to warrant any thought of resection. The gut was returned to the abdomen, and the abdomen closed by through-and-through sutures, with one suprapubic drain to the pelvis. The operation was performed without any anæsthetic, with the exception of during the manipulation of the intestines when a small amount of nitrous oxide and oxygen was administered. She was returned to the ward in grave condition, and died the same night.

The reporter remarked that the interesting factors in this case include a method for determining the level of pain loss in cases where chordotomy is indicated, and this method can be accurately determined by examining the patient during the cutting of the anterolateral columns, under local anæsthesia. The sensory supply for pain to the peritoneum is another most interesting point in this case. It was not only possible to make an exploratory incision on the right side of the abdomen in this field of anæsthesia, without the patient's knowledge, but Doctor Owen noted the absence of any pain while manipulating or opening the parietal peritoneum. The visceral peritoneum, however, was painful, and required a slight gas anæsthesia in order to attempt surgical relief of the torsion and obstruction. This is evidence that pain fibres are supplied to the visceral peritoneum, either bilaterally from the side which still had pain sensation in the upper thoracic segments, or, that these pain fibres reach the cord at a level higher than the third thoracic segments, and hence that the pain experienced by the patient was carried by fibres which reached the cord, either on the left side or above the third thoracic segments.

Another interesting phase of this case was the masking of symptoms due to the chordotomy, and probably somewhat due to the presence of tabes. The absence of rigidity implies some factor associated with pain that was disturbed, or must be considered from the standpoint of her tabes. It is difficult to estimate whether the constriction of the mesentery by the band of adhesions first aggravated her abdominal pain, but in as much as her pains preceded her formal abdominal operation, and were not relieved by it, the possible source of adhesions following the former abdominal exploration does not lend sufficient weight to the consideration of intermittent obstruction as responsible for her pain. A clear-cut case of tabes makes the condition probably one of typical gastric crises, the sudden intestinal obstruction being an unusual complication.

DR FRANCIS C GRANT said that the indications for chordotomy in gastric crises are clean-cut paroxysmal pain of such severity and frequency that

the sufferer is economically incapacitated. The term "economically" is used advisedly because infrequent attacks of abdominal pain are not sufficient indication for an operation such as chordotomy. In properly selected cases the results are quite satisfactory. In the past few years, he has performed six chordotomies for gastric crises. Three patients are alive, self-supporting and pain free. One death from luetic myocarditis occurred six weeks following operation as a direct result of the procedure. In this case vesical incontinence was noted. But in none of these patients was pyramidal tract involvement with impairment of motor function observed.

Doctor Fay has made an important observation in confirming Foerster's claims that the fibres for pain and temperature decussate promptly on entering the cord. It was hitherto supposed that these fibres travelled up the cord for several segments before crossing to the opposite side. Knowledge of this fact is of value for it indicates that chordotomy may be done at a lower level than hitherto supposed, provided that the section in the anterolateral columns completely severs all the fibres. It also obviates the necessity of sectioning posterior roots above and below the incision into the cord. The speaker has felt this latter precaution to be particularly indicated in relieving pain from gastric crises since cord section at the fourth thoracic segment, the point of election, is not more than three or four segments above the region where pain fibres from the abdominal viscera presumably enter the cord. Doctor Grant believes that chordotomy under local anæsthesia is a little hard on the patient. To be sure he has only seen one case performed in this way. Although it was carried through by a surgeon skilled in the procedure and while every effort was made to prevent unnecessary distress, manipulation of the posterior roots caused considerable pain. In *tabes dorsalis* these roots are bound down by adhesions as is the cord itself, and considerable handling is necessary to free them so that the cord can be turned to perform properly the section of the anterolateral tracts. Curiously enough section of the cord itself is not painful.

The most interesting part of Doctor Fay's observations has to do with differentiation of the tracts for pain and temperature. As he states, it has been long suspected that the fibres subserving these sensations ran in separate areas. That he was able by careful sectioning to produce thermæsthesia without loss of pain sense confirms these opinions held heretofore on largely theoretical grounds. From the physiological and neuro-anatomical points of view this observation may justify the use of local anæsthesia. From the technical standpoint the speaker did not see how the method of section of the tracts described by Doctor Fay is an improvement on the method described by Frazier. In the case here reported, even with the use of local anæsthesia, motor weakness resulted, nor was the sensory level any higher than that obtained when a chordotomy hook is properly inserted into the cord and the section made.

While this report has added distinctly to our knowledge of the course of the pain and temperature fibres within the cord, Doctor Grant is sure that most surgeons will feel that our present methods of local anæsthesia are

inadequate sufficiently to control pain produced by the manipulations necessary to free delicate structures like the posterior roots from the adhesions which surround them in tabes. Since the carefully standardized technic described by Frazier can be used so successfully with general anaesthesia, whereby unnecessary pain to the patient is avoided, it seems unwise to abandon it even if thereby obscure anatomical problems may be solved.

DR TEMPLE FAY remarked that in most chordotomies, including several cases which he recalled on the Frazier service and in his own experience, one does get a traumatic myelitis associated with motor weakness, following operation, which may last for one week or ten days. It is due to trauma of the cord at the time of the chordotomy and does not necessarily indicate the section of the pyramidal fibres. The return of motor function is evidence that it must be due to trauma, and not to section, as no return of function ever occurs after destruction of the fibres within the spinal cord.

As to the type of anaesthetic, there is no doubt the patient is less comfortable under local, and yet with it one knows exactly what he is doing and the neurologist is able to tell the operator when he has cut the desired number of fibres, which he wishes to select. In the other cases also described, Doctor Wilson and the speaker were able not only to do a chordotomy, but to take away only the supply of pain from the right hip and leg. They did not want to destroy pain any higher than the hip and therefore preferred this method. Whether there is a greater hazard of destroying more than one wants to under general anaesthesia it is difficult to say. Doctor Spiller has added a further refinement of his operation, which, with improvement in our technic of local anaesthesia, will be even more acceptable.

GASTRIC CRISIS COMPLICATING CANCER OF PYLORUS

DR HUBLEY R. OWEN reported the case of a man, fifty years of age, who was admitted to the Woman's College Hospital October 22, 1925, with the chief complaint of rapid loss of twenty-five pounds in weight, general malaise, weakness and abdominal pain.

For about six months prior to his admission to the hospital this man had been having pain in the upper abdomen. The pain was severe in character, it had no relation to the taking of food. There was a sense of constriction around the upper abdomen. The pain was not referred and was unassociated with nausea and vomiting until recently. During the three weeks prior to admission to the hospital, he had lost twenty-five pounds in weight. His pain, which was occasional at first, during the past three or four weeks, has been constant and he has been nauseated and has vomited at frequent intervals. At no time has the vomitus contained blood.

When admitted the abdomen was fairly well nourished but the appearance of the tissues indicated loss of weight. No tumor nor masses could be felt. Patient complained of subacute tenderness on deep palpation of the epigastrium. No tenderness in the region of the gall-bladder nor appendix. Rectal examination revealed no abnormality. The patient had Argyll-Robertson pupils, a fine tremor of his hands, slight exophthalmos, complete loss of knee-jerks. Romberg's sign present. Haemoglobin 65 per cent, red blood cells 3,250,000, white blood cells 9600. Examination of gastric contents showed no free hydrochloric acid, presence of lactic acid. *Blood chem-*

POST-OPERATIVE MASSIVE ATELECTASIS

1st y Blood sugar 110, blood urea 18 Urine normal other than a trace of albumen Wassermann was plus four in both antigens

During the patient's stay in the hospital he had frequent attacks of severe girdle pain sometimes accompanied by vomiting He frequently had the pain without either nausea or vomiting *X-ray examination* was as follows "There is a marked irregularity in contour about the pylorus with retention of the barium meal over seventy-two hours No complaint of pain on manipulation of the stomach Second examination of the stomach showed the same deformity and retention The colon was negative "

The man was put on antiluetic treatment but continued to lose weight He was operated upon October 30, 1925 A firm mass at the pyloric end of his stomach was disclosed, the stomach was dilated and thickened, the pylorus was greatly constricted and would not admit the end of the index finger, the mass was freely movable No glands could be felt As the mass was practically free of adhesions and as there was no evidence of metastasis, pylorotomy was performed About one-third of the pyloric end of the stomach was removed Following the operation the patient made a smooth recovery He was discharged from the hospital November 16, 1925, and referred to the neurological service of the Medical Division, Department of Public Safety, At that time he was complaining of severe neuritis over the nerve trunks of the lower extremities He reported for duty February 22, 1926, four months after his admission to the hospital Shortly after this date, in spite of antiluetic treatment, his eyesight began to fail and the neuritis continued He was admitted to the Philadelphia General Hospital February 19, 1927 It was found that he had advanced mitral and aortic lesions of his heart and a mass in the epigastrium He had incessant vomiting, rapid emaciation and died in the Radiological Ward March 12, 1927

The case is reported in conjunction with the previous case because of the confusing symptoms of girdle pains associated with a luetic lesion The symptoms were typical of tertiary syphilis An operation was agreed upon before a prolonged course of antiluetic treatment could be tried because of the X-ray findings and the result of the gastric analysis Neither ulcer nor malignant growth was at first suspected

The pathological report on the specimen removed was adenocarcinoma of the stomach

POST-OPERATIVE MASSIVE ATELECTASIS BRONCHOSCOPIC ASPIRATION

DR CALVIN M SMYTH, JR, reported the case of a young woman, nineteen years of age, a student nurse, who was taken ill May 13, 1928 She was admitted to the nurse's infirmary on that day with the diagnosis of acute appendicitis She had had occasional attacks of pain in the right iliac fossa during the past year Aside from this, and two attacks of tonsillitis, her health had always been excellent Appendicectomy was performed on the afternoon of the day of admission, ten hours after the onset of the attack The operation was done under nitrous oxide and oxygen anæsthesia no ether being employed The appendix which was acutely inflamed and on the verge of perforation was easily and quickly removed through a small McBurney incision and the abdomen closed without drainage During the operation the patient did not cough, strain, vomit or become cyanosed There was no vomiting during the period of reaction from anæsthesia

On the following day a slight cough developed and a few squeaky rales could be heard at the left apex. Forty-eight hours after operation the axillary temperature rose to 103.6° , and the pulse to 170. She became delirious. Examination of the chest at this time showed the apex beat to be displaced

to the left anterior axillary line. The entire left chest was flat to percussion and the breath sounds were almost inaudible except at the apex. The patient was quite cyanotic, appeared to have great difficulty in breathing and complained of a tugging or dragging in the left chest. Early the following morning she had a severe attack of dyspnoea which was relieved when she coughed up a small mucous plug. The diagnosis of massive atelectasis having been confirmed by X-ray examination (Fig 2), she was placed on the sound side and encouraged to cough. The condition failed to materially improve and the patient's general condition became weaker. On May 18, five days following the operation and three days after the development



FIG 2—Appearance of chest immediately before bronchoscopic aspiration

of the atelectasis, X-ray failed to show any improvement and she was seen in consultation by Dr. Gabriel Tucker, who advised immediate bronchoscopic aspiration.

The bronchoscope was introduced through a laryngoscope, the right main bronchus was clear but the left was tightly plugged. Aspiration removed about five cubic centimetres of thick, tenacious material which later was found to contain the pneumococcus in pure culture. The reaction of the patient to this procedure was immediate and spectacular. The left chest which had been completely immobile expanded and the tugging sensation, of which she had previously complained, disappeared. X-ray examination made within fifteen minutes after the bronchoscopy showed the lung filled with air (Fig 3). The patient passed a comfortable night and on the following morning coughed up several plugs similar to the one aspirated. The physical signs in the lung and the position of the apex beat rapidly returned to normal. There was no elevation of temperature after the aspiration and convalescence from the appendicectomy progressed uneventfully to recovery. The patient was discharged May 29, nineteen days after the original operation and twelve days after the bronchoscopic aspiration.

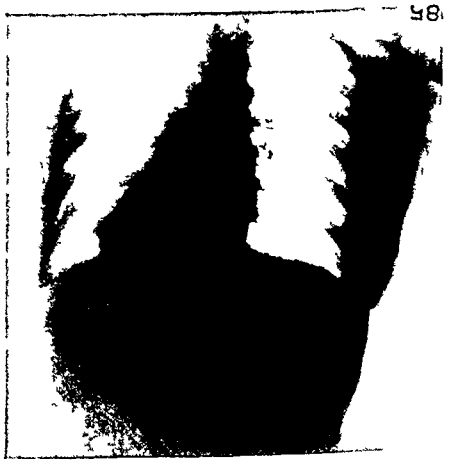


FIG 3—Appearance of chest fifteen minutes after aspiration

The thing which impressed everyone who saw this patient was the complete absence of pain or shock occasioned by the bronchoscopy. The patient herself said immediately following the procedure that, while of course it was uncomfortable, the relief was so great that she would not hesitate to have it done again. Doctor Smyth remarked that he was reporting this case not on

POST-OPERATIVE MASSIVE ATELECTASIS

account of anything unusual in the condition, but to again call attention to the fact that massive atelectasis could be relieved immediately and with complete safety by bronchoscopic aspiration. Treated by expectant and more conservative measures it usually required about three weeks for the lung to be restored to its normal condition.

DR CHARLES F NASSAU said that he wondered if these conditions of collapse of the lung are ascribed to the anæsthesia. He had a patient seven weeks ago who was operated upon under spinal anæsthesia, and who developed massive collapse of the lung the day following operation. He went down as fast as though struck with an axe. Doctors Clerf and Tucker were not available so he had to turn the patient on his good side and trust to luck. The following evening, after thirty-six hours, he was so much better without bronchoscopy that Doctor Clerf said to let him alone. He made a good recovery.

Regarding local anæsthesia, the speaker remarked that he had been doing a great part of his work with this form of anæsthesia for twenty-five years and had never seen massive collapse of the lung following it.

DR WALTER E LEE said that it is generally admitted statistically that the incidence of post-operative pulmonary complications is as great, if not greater, following local anæsthesia as occurs after general anæsthesia.

The first bronchoscopic drainage of a case of post-operative massive collapse was done by Doctor Tucker at the Germantown Hospital in 1923. Since that time nineteen cases have been drained bronchoscopically by Doctors Tucker and Clerf of the Chevalier Jackson Clinic. We must admit that we are peculiarly favored in Philadelphia in having available trained bronchoscopists to treat these emergencies, and the immediate relief that has been obtained in every one of these cases has more than justified the treatment. In only one of them was it necessary to repeat the drainage. In the hands of a skilled bronchoscopist we can testify that it is not as formidable a procedure as one would imagine. It is usually completed in three to five minutes and the immediate relief experienced by the patient has convinced them of its value and all of them have said that they would willingly have it repeated, if necessary. In a recent case by Doctor Clerf, when threatened with a second bronchoscopic drainage, because the patient refused to cough up the obstructing bronchial secretions he said "Bring on the bronchoscope, I would far rather have that than the pain of coughing."

It must be remembered that the purpose of the bronchoscopic drainage is not to completely remove the masses of bronchial secretions, but to relieve the point or points of bronchial obstruction and establish an airway beyond these obstructions, and thus restore the cough reflex and stimulate the patient to expel these masses of secretion. That the obstruction is due to the sticking of the tenacious material to the walls of the bronchi has been demonstrated time and time again at the time of the bronchoscopic examination. Undoubtedly, in the large majority of cases, this obstruction is overcome by the patients themselves and they will give you the history of coughing up

large quantities of sputum following some change of position or some sudden excitement, and after the expulsion of the secretion their subjective symptoms will be immediately relieved. Doctor Santee has actually observed this relief of obstruction under the fluoroscope when he was examining a patient and his suggestion that we turn the patient on the opposite side is at times all that is necessary.

Doctor Scott, of Rochester, has suggested a very valuable procedure in the use of inhalations of carbon dioxide to increase the depth of inspiration, thus restoring the cough reflex and promoting the expulsion of the tenacious secretion. If one understands the mechanism of post-operative collapse and appreciates that the therapeutic indications are the relief of bronchial obstruction and the establishment of an airway so that the cough reflex will be restored, he can intelligently employ these measures. In the early stages, deep breathing or a change of posture may be all that is necessary. In the same period or a little later, the deep inhalations of carbon dioxide may suffice but after a lapse of several days, because of the gradual increasing viscosity that follows the loss of the fluid content of the secretion, bronchoscopic drainage should be considered. In the later stages, the simpler procedures are rarely successful, while bronchoscopic drainage gives immediate and positive relief.

Present experience shows that bronchoscopic drainage is not a formidable procedure, and after simpler measures fail, the patient should always be given the benefit of such a procedure.

BULLET WOUND OF INTESTINES AND KIDNEY WITH NEPHRECTOMY

DR BENJAMIN LIPSHUTZ presented a man thirty-eight years of age, who was admitted to the Mt Sinai Hospital January 19, 1929. Twenty minutes before admission to the hospital while bending over, a revolver dropped from his pocket and discharged, the bullet entering a little below and to the left of the umbilicus. He immediately complained of violent abdominal pain and began to feel faint, the speaker saw him one hour later, he was in shock. The pulse was feeble, rate about 90, blood pressure 70, examination of the abdomen showed diffuse tenderness and rigidity, and palpation over the back showed the bullet below between the eleventh and twelfth ribs. Immediate operation was carried out under local anæsthesia, supplemented with nitrous oxide and oxygen. An upper left rectus incision was made, on opening the abdomen free blood clots and intestinal contents were disclosed. Examination of the spleen, pancreas and liver disclosed no injury. The intestine, namely, the upper ileum and jejunum as far as the duodenal-jejunal junction disclosed fifteen perforations, these were closed with interrupted Lembert sutures, care being taken to avoid any occlusion of the lumen. Bleeding still continued, and examination of the root of the mesentery showed a point of rupture which was oozing blood, the bleeding points were ligated and the rent in the mesentery closed with ligatures. The root of the mesentery of the jejunum also disclosed a site of oozing and an increasing hematoma, the latter was opened and found to contain blood clot. Bleeding points were ligated and the mesenteric wound closed. Bleeding still persisted from the posterior part of the abdominal cavity and the presence of a large dark red swelling over the region of the kidney indicated evident accompanying injury to the kidney or one of the so-called massive hæmorrhages of the renal bed. The parietal peritoneum was separated from the abdominal

OPERATIONS ON GALL-BLADDER AND DUCTS

wall laterally and posteriorly in order to gain access to the kidney through the abdominal incision. Here it was found that bleeding was violent and active. The renal artery was not ruptured but the vein was injured and the kidney was torn to a pulp. A rapid nephrectomy was performed. The abdominal wound was closed and a stab wound made posteriorly through which a gauze pack was introduced. Convalescence was smooth except for the first forty-eight hours when liquids were limited and marked slowing of absorption was noted. The wound healed by first intention with the exception of stitch infection at the upper angle of the incision. He recovered satisfactorily and is now returned to work.

This case is an excellent example of the value of intraperitoneal exposure of the kidney in an acute injury involving the abdomen and kidney. It permits the surgeon with relatively little loss of time and no danger from increased shock, to handle both the abdominal injury and the renal injury.

In going over the statistics of associated abdominal and renal injuries, those available are largely concerned with cases the result of war injuries and it seems hardly fair to compare them with civil injuries. The prognosis is almost hopeless. In the British war statistics of 2121 cases of abdominal wounds, 155 were associated with a kidney injury. In Laewen's statistics of 159 cases, twenty-nine had accompanying renal injury, and he stated that from his personal experience of thirty-four cases of combined renal and intestinal injury, but three recovered and he thinks the prognosis almost hopeless. In the German literature, Most reported seven cases and all died. In the review of the American experience as to whether to explore the kidney first and then the abdomen or *vice versa*, the opinion was for the former because of the danger of carrying infection from the intestinal contents into the retroperitoneal tissue. But with the technic followed here, the danger of contamination is little.

Doctor Lipshutz has had three cases of this type of injury, in two other instances the kidney was not injured but there was the so-called massive hæmorrhage of the renal bed with a large hematoma, and the same method of approach was used. Exposure is rapid and the presence of the hematoma aids the surgeon to rapidly detach and separate the peritoneum.

DR CHARLES F. NASSAU said that the most important thing in this case was the recognition of the damage to the kidney or renal vessels. Whenever one opens the abdomen for gunshot wound and finds considerable hæmorrhage back of the peritoneum, it should be determined by one method or another (stripping the peritoneum or drawing back to expose the kidney) how much hæmorrhage there is and its origin. Otherwise one may do a wonderful operation on the intestinal perforation and still lose the patient from a kidney injury.

REVIEW OF THE OPERATIONS DONE ON THE GALL-BLADDER AND DUCTS

DR JOHN H. GIBBON read a paper with the above title for which see page 367.

DR JOHN H. JOPSON remarked as to the choice of operation, that he had a well-defined practice of his own, which he has modified in recent years fol-

lowing disasters in older people, he agreed with Doctor Gibbon that 70 per cent of diseased gall-bladders can be removed with benefit to the patient. In patients over sixty, however, where there is some question as to the condition of the myocardium and where the operation of cholecystectomy seems to have a reflex action on the circulation, post-operative death has occurred, due to a failing myocardium, and so he has come to look with a doubtful eye upon cholecystectomy as a routine procedure in these older patients. Of course, after cholecystectomy he has had recurrences and in one case he removed the gall-bladder ten years afterward.

Following cholecystostomy in younger patients he believed about 50 per cent would have recurrence, but in patients sixty or over unless there is some organic change in the gall-bladder which clearly calls for its removal, he is satisfied with cholecystostomy. In certain other cases of gangrene or virulent infection of the gall-bladder, the less done the better (just as in other parts of the body), and it has always seemed that quick drainage and quick retreat were in order. In the cases between these two groups, with the thick and œdematous gall-bladder which will probably never return to a normal and healthy condition, the speaker had in several instances practiced with satisfaction the subtotal operation, resecting the gall-bladder and leaving about one-fifth of it into which a tube for the drainage of bile is sewn. As to the recurrence of symptoms after operation for obstruction of the duct whether this is due to operative injury or to stenosis following ulceration of the duct from pressure of calculi, he noted that Doctor Gibbon believes it may be due to ascending infection from the gastro-intestinal tract. One knows that the further down the anastomosis is made, the more frequent subsequent infection usually is. There is probably no difference in this respect between stomach and duodenum, and the most successful result the speaker has seen followed the implantation by him of the injured duct into the stomach. The results have been excellent and the danger of injury to the ducts is minimized.

DR GEORGE P MULLER said that he performed cholecystostomy in most cases of empyema because he feels that when one has ripped the gall-bladder from the liver and opened up the connective tissue spaces to find the cystic duct, one has opened up avenues for infection, because all the lymph from an infected gall-bladder must be infected, and it adds to the spread of infection. Some time ago he performed cholecystectomy in most cases of empyema, but last year reversed the procedure and performed cholecystostomy. The mortality was lower. On the other hand, dilatation of the common bile duct following cholecystectomy does not occur unless a normal gall-bladder has been removed. Doctor Gibbon thinks that a compensatory dilatation has already occurred and that the patient has had time to become used to such a phenomenon. This may be so but when definite pathology is present in the gall-bladder with the jeopardy of life from acute infection, the speaker cannot see the wisdom of doing anything but cholecystectomy, except in old

people, because in them the period of time in which gall-stones may recur is limited and the number of times must necessarily be small

DR J STEWART RODMAN said that while he had never seen an attempt of the gall-bladder to reform from the stump of the cystic duct, he would ask Doctor Gibbon if he has done so. He recalled that Doctor Sweet reported some experimental work a few years ago to this Academy showing that such might happen

DR CALVIN M SMYTH, JR, said that the work of Sweet, referred to by Doctor Rodman, had been done by Doctors Hartman, Wood and himself in Sweet's laboratory in 1916 and had been published in the ANNALS OF SURGERY in a paper entitled "The Results of High Ligation of the Cystic Duct in Cholecystectomy." Two cases of reformation of the gall-bladder were reported, in one of the cases reformation of stones had occurred. Attention was also called at that time to the generalized dilatation of the common bile duct and all of the branches of the hepatic duct which occurred following cholecystectomy

DR ASTLEY P C ASHHURST remarked that he was what might be called a "cholecystectomist." He recalled receiving, a few years ago, a questionnaire asking how many cholecystostomies he had done in the previous two years. On looking up his records to reply, he found he had not done any in that length of time. Since then, he has done four cholecystostomies. The speaker looks upon the diseased gall-bladder as a menace and thinks it deserves to be removed, especially if it has stones in it

Doctor Gibbon had left several impressions on his mind. *First* that he thinks the recurrence of symptoms after a cholecystostomy may be due to the escape of stones from the common duct (where they were overlooked) into the gall-bladder. Doctor Ashhurst does not believe this can occur, and probably misunderstood him. *Second*, that he thinks the existence of a dilated common duct means obstruction to the duct and that it should, therefore, be explored. In cases of functionless gall-bladder, the common duct is already dilated and as the dilatation means that the gall-bladder is of no use, the gall-bladder should be removed. The speaker is not in the habit of opening the common duct unless there is evidence at the time of operation that it has been or is still diseased

DR JOHN H GIBBON said that Doctor Jopson's statement that the higher the anastomosis with the gastro-intestinal tract, the less likelihood of infection is interesting. Most of the speaker's cases have been with the duodenum. In the experimental work with dogs, the anastomosis was to the stomach and yet they all developed this type of infection

The object of his paper was to encourage the exercise of judgment, of brains, and of thought in the performance of an operation and its selection and not to go at it mechanically. Doctor Gibbon did not wish to leave the impression that in common-duct disease due to non-function of the gall-bladder the duct should be opened, what he wanted to make clear was that

when stones are found in the gall-bladder and the common duct is dilated, one ought not to be content with palpation, because one cannot always feel stones in the presence of dilatation, and it is wiser to operate in such cases. His point was for the removal of any stone rather than with the idea of opening the dilated duct. Also, he said that he did not know that this dilatation of the duct is harmful. Judd at an American Surgical Association meeting showed a case of dilatation of the entire biliary tract after removal of the gall-bladder, so that it would seem that dilatation does take place where the gall-bladder is out of commission due to disease. Removal or obliteration of the gall-bladder causes a compensatory dilatation of the duct. Division should be done down close to the common duct, a number of operators think the only thing necessary is to take the gall-bladder out and they often overlook this important point and do a great deal of harm. It must be taken out close to the common duct, regardless of the situation.

STATED MEETING HELD MAY 7, 1929

The President, DR ASTLEY P. C. ASHURST, in the Chair,
CALVIN M. SMYTH, JR., M.D., Recorder

COLORED MOTION PICTURES OF SURGICAL OPERATIONS

DR WALTER E. LEE demonstrated a film of motion pictures of operations, made in colors. These pictures represented the first attempt to make colored reproductions with the artificial light of the operating room. A great handicap has been that in looking at a black and white picture, one keeps trying to interpret the film in colors and this makes it an effort to follow the technic. The speaker did not consider the demonstration perfect but presented the film because it seemed to be the first evidence of success in attempts to employ this method of teaching surgical technic.

TENDON TRANSPLANTATION FOR WRIST DROP

DR DE FOREST P. WILLARD presented a man who was injured September 27, 1926, when he received ten fractures of the right upper extremity and an injury to the musculo-spiral nerve. At least three of the fractures were compound. He was treated at St. Luke's Hospital, Bethlehem. Open reduction of the fractures of the radius, ulna and humerus were done. All the fractures healed without infection. In April, 1927, a bone-grafting operation was performed for an ununited fracture of the middle of the humerus. In May, 1928, the musculo-spiral nerve was operated on for persistent wrist drop. The nerve was found to be a mass of fibrous tissue, and union of the nerve tissue was found to be impossible. During the past winter he was examined by neurologists in New York and Philadelphia, and further nerve operations were considered useless. Tendon transplantation was suggested. After full discussions of his needs, it was decided that individual extension of his fingers was not necessary, but that strong extension of the fingers to the 180° position and sufficient extension of the thumb extensor and one to the common extensor. This procedure usually functions well for a short period of time, but the weak flexor often proves inadequate for the necessary work and the tendon stretches and the finger flexion recurs. In this patient scars of the operative incisions on the bones of the forearm

ADENOMA OF THYROID WITH TORSION OF LARYNX

lay in the paths of the tendon transplants and it was felt that these might interfere with muscle function. Therefore, to give greater extensor power, the following operation was done January 22, 1929. The flexor carpi radialis was freed from its insertion, dissected back as far as possible and passed around the radial side of the forearm. It was then passed through the extensor tendon of each finger separately (proximally to the annular ligament) and sutured with silk to each tendon. The flexor carpi ulnaris was treated similarly and brought to the extensor surface around the ulna and sutured to each extensor tendon in the same way. This gave the combined pull in the normal direction of the extensor tendons and prevented the dislocation of the extensor tendons to either the radial or ulnar side. The palmaris longus tendon was also freed from its insertion and brought over the ulna and sutured into the long extensor of the thumb. Assisted active motion was started on the third day to prevent the formation of adhesions and active motion began on the seventh day. In ten days the patient was able to actively extend the fingers and strong extension to 180° was obtained in four weeks. He has now actively used his hand for nearly three months and muscular power is increasing.

The case is reported in the belief that the transplantation of two flexor tendons into the finger extensors, one passing on each side of the forearm, will give stronger and more powerful function.

DR WALTER G. ELMER said that this is the most perfect restoration of function following tendon transplantation in the forearm that he has even seen.

ADENOMA OF THYROID WITH TORSION OF LARYNX

DR FREDRICK A. BOTHE reported the case of a negress, sixty-two years of age, who was admitted to the Presbyterian Hospital December 20, 1928, in the service of Dr. John Speese, through whose courtesy the reporter was permitted to operate upon this patient and report the case. The patient gave a ten years' history of the gradual development of a thyroid tumor until it had reached the size of a medium-sized grapefruit seated on the left side of her neck but extending well to the right of the midline. Attacks of tachycardia, choking spells and hoarseness have become increasingly frequent and severe.

The patient was placed under the routine management for a toxic adenoma and in addition steam inhalations were administered to decrease the acute congestion of the epiglottis and larynx which was super-imposed upon the chronic congestion. Eight days after admission to the hospital the adenoma was removed under local anæsthesia. The pathologist pronounced it a toxic foetal adenoma. Immediate relief from the choking spells was obtained following the operation but the hoarseness of the voice did not disappear for three weeks. At this time a second laryngoscopic examination was made by Doctor Cariss. The œdema of the epiglottis and the arytenoid area had disappeared. The larynx had returned to the midline and both the true and false vocal cords were normal in position and appearance. She was discharged from the hospital January 24, 1929, twenty-seven days after operation, feeling much stronger, was relieved of the choking spells and hoarseness. Her pulse rate had settled down to 82, was of good volume and her blood pressure had fallen to systolic 138 and diastolic 70. She returned to the Follow-Up Clinic four months after the operation and was relieved of the local symptoms which the adenoma had caused. She had not regained her entire normal strength but was able to do a part of her housework for

the first time in two and one-half years. An X-ray picture of the chest showed the trachea had returned to the midline. She still experiences occasional mild attacks of tachycardia and palpitation. Her nervousness had greatly decreased but had not entirely disappeared.

The degree of torsion of the larynx with œdema of the epiglottis and arytenoids and the marked posterior lateral displacement of the common carotid artery were the findings which prompted the report of this case. The outward displacement of the common carotid artery is of diagnostic value in adenomatous goitres, as in tuberculous or malignant tumors this artery lies in the centre of the mass.

GANGRENOUS INFECTION OF THE HAND AND FOREARM FOLLOWING HUMAN-BITE

DR JOHN B. FLICK reported the case of a negro man, aged thirty years, who was admitted to the Pennsylvania Hospital December 30, 1927, with the history of having been bitten on the right thumb by another negro five days previously while engaging in a street fight. The hand was greatly swollen, he had a temperature of 102° F and seemed toxic. The hand and forearm were incised under a general anæsthetic and pus evacuated. The

tissues exposed in the wound were œdematous and had a peculiar greenish-gray appearance. The odor was most offensive and reminded one of that which is given off in spirochætal pulmonary gangrene. A dark field examination of the pus from the hand showed numerous organisms, some of which were motile and which were



FIG. 1.—Infection of the hand and forearm following human bite, showing the extensive destruction of tissue.

thought to be spirochætes. Subsequent smears showed definitely the presence of spirochætes. A non-hæmolytic staphylococcus albus was isolated on culture, but no growth of the spirochætes was obtained. A guinea pig inoculated in the groin remained healthy. It was killed almost two months later.

Five days after the patient's admission to the hospital it was noticed that he had jaundice and he began to have chills and sweats. There was extensive destruction of tissue in the hand and forearm and amputation of the forearm was advised (Fig. 1). This the patient refused. A blood culture taken at this time failed to show a growth. The patient died on January 9, 1928, sixteen days after the injury was received.

While the type of spirochæte was not identified nor the fusiform bacillus of Vincent isolated, this case suggested that the organisms of "Vincent's Angina" so often found in the human mouth might be factors in determining the seriousness of human bites. With this in mind the reporter searched the literature for cases similar to the one cited.

Hennessy and Fletcher report the case of a Malay who was bitten on the left forearm and thumb by another Malay and who developed an infection of the thumb with extensive destruction of tissue and disorganization of the thumb joints. The pus from the wound contained fusiform bacilli and enormous numbers of spirochætes. They refer to other cases reported

GANGRENOUS PANCREATITIS

by Peters The following is taken from Hennessy and Fletcher's article 'The infection of wounds caused by the teeth has been reported by Peters In one instance a laborer injured his fingers by striking a man in the mouth The injury was followed by intense swelling, œdema, and a foul discharge in which fusiform bacilli were discovered in association with streptococci, but without spirochætes The same author describes the case of a bartender who hit a man in the mouth and injured his own hand Despite free incisions and soaking in antiseptic lotions there was deep destruction of tissue and the hand did not heal for fifty-four days In this instance great numbers of spirochætes were associated with the fusiform bacilli Peters also mentions the case of a seven-year-old child who suffered from partial gangrene of one of her index fingers as the result of infection with spirochætes and fusiform bacilli attributed to the child's habit of biting her nails with her canious teeth' P H Hennessy in another article, again reports the Hennessy-Fletcher case given above and adds four cases in which the appearance of the lesion, the character of the pus and the course of the disease strongly suggested infection with the organisms of "Vincent's Angina" but in which no bacteriological studies had been made A common feature of all the cases reported seems to have been an extensive destruction of tissue

DR HUBLEY R OWEN showed some slides demonstrating similar cases, although he stated the condition in them was not as severe as the form of gangrene Doctor Flick had discussed He stated that most of the cases which had come to the attention of the Police Surgeon's office had previously been sewed up in some dispensary While he said he was not prepared to say what was the really correct method of first-aid treatment in these conditions, it is not suturing In his service he has tried every method of treatment, including the actual cautery and Dakin's solution and still has considerable trouble in preventing ankylosis of the metacarpal and phalangeal joints

GANGRENOUS PANCREATITIS

DR ELRIDGE E ELIASON and (by invitation) DR JAMES LACEY reported the case of a woman, fifty years of age, who was admitted to the University Hospital, in the service of Doctor Eliason, November 30, 1927, with the chief complaint of abdominal pain and vomiting

For the past year before admission she had complained of repeated attacks of nausea and vomiting, followed by severe, steady, generalized abdominal pain The severity of the attack was usually over in four hours and she was entirely relieved of symptoms in twenty-four hours There was no jaundice or loss of weight On admission the patient was having an attack which had lasted four days and was more severe than any previous attack

On physical examination the abdomen was tender throughout, most marked in the epigastrium There was rigidity in the epigastrium and moderate distention throughout the abdomen Peristalsis was practically inaudible On the day following admission the tenderness and rigidity seemed more marked on the left side of the epigastrium The leucocytes were 29,200 and the hæmoglobin was 100 per cent The plasma carbon dioxide was 47 volumes per cent The urine contained urobilin and bilirubin

The temperature, pulse, and respiration on admission were 99.2-104-20. A diagnosis of cholelithiasis was made on admission. With the shifting of the pain and tenderness and rigidity to the left side of the abdomen on the morning after admission, an additional diagnosis of acute pancreatitis was made.

At operation, December 2, 1927, the peritoneal cavity was found to contain chocolate-colored fluid and fat necrosis was seen in the peritoneum. The pancreas was swollen and indurated. The entire gland was black in color and gangrenous throughout. The gall-bladder was opened and found to contain several hundred small, yellow stones which were evacuated. No stones were palpated in the common duct. The gastrohepatic omentum was opened, exposing the pancreas. Drainage of the pancreas was established by multiple cautery incisions. The gall-bladder and pancreas were drained, externally.

The post-operative course was stormy and on the fifth day she developed the physical signs of atelectasis of the left lower lobe. The temperature, pulse and respiration remained elevated, the abdomen was distended and there was distressing hiccough. On the thirteenth post-operative day the signs of fluid were demonstrable in the left chest. The blood sugar ranged from 135 to 99 milligrams per 100 cubic centimetre of blood, the patient being on a diabetic diet with insulin. The abdominal wound drained profusely of necrotic material. On the fourteenth post-operative day a small amount of straw-colored fluid was removed from the chest. Aspiration was repeated six days later and 100 cubic centimetres withdrawn. On the twenty-eighth post-operative day a fluctuating mass was palpated in the left upper quadrant. On the thirty-eighth post-operative day the patient was again operated upon and an abscess near the tail of the pancreas drained through the subcostal region of the left loin. This operation was followed by marked improvement. Forty-nine days after operation the chest was again tapped and 650 cubic centimetres of fluid removed. Following this both wounds drained profusely though the temperature was slightly hectic. The patient was allowed out of bed after seventy days from the original operation. A peculiar feature was noted during irrigations of the abdominal wounds, the patient would cough and taste the irrigating fluids and a diagnosis of abdomino-bronchial fistula was made. However, improvement continued and the patient was discharged February 28, 1928, three months after admission. At present she is apparently in perfect health.

INCARCERATED RETROCECAL HERNIA—GANGRENOUS APPENDICITIS

DOCTOR ELIASON presented a man, sixty-five years of age, who was admitted to the University Hospital in the service of the reporter, November 20, 1927, whose chief complaint was pain in the lower abdomen, nausea and vomiting and constipation. Seven days prior to admission he drank heavily and ate various sea foods. The next day he complained of pain in the lower abdomen, followed by nausea and vomiting. He was confined to bed from then on, the pain became worse and localized in the right lower quadrant. Vomiting continued and there was no bowel movement from onset to admission.

On admission the temperature and pulse were normal. The blood pressure was 115S-50D. The patient was emaciated and weak. The leucocytes were 17,800. The abdomen was distended and tympanitic. There was tenderness in the lower abdomen, especially the right lower quadrant, where a mass could be palpated. A diagnosis of appendiceal abscess was made and the patient was operated upon immediately. The right lower quadrant

PERFORATED PEPTIC ULCER

was opened through a gridiron incision and a loop of terminal ileum was found to be incarcerated in a retrocaecal hernial sac, with a tightly constricting neck. On stretching the neck of the sac the hernia was found to consist of about six inches of terminal ileum and the appendix which was gangrenous. The ileum had perforated just within the constricting neck and the sac contained pus and some liquid faeces. The perforation was oversewed and the appendix removed. The opening of the pouch was repaired around a drainage tube and an ileostomy was done proximal to the obstructed loop.

The immediate post-operative course was complicated by delirium tremens which cleared up in forty-eight hours. Normal bowel movements started on the fourteenth post-operative day and the ileostomy tube was removed. The patient was discharged December 9, 1927, on the nineteenth day after admission. He is now perfectly well.

PERFORATED PEPTIC ULCER

DR ELRIDGE E ELIASON presented a man, twenty-nine years of age, who was admitted to the Howard Hospital May 26, 1922, on account of pain in the abdomen, vomiting and weakness.

The history of illness started three years prior to admission, when the patient was seized with severe pain in the abdomen. Following this attack he was confined to bed for one week. During the intervening three years the patient had repeated attacks of abdominal pain following the ingestion of sweet foods or occasioned by worry. One week before admission he experienced an exceptionally severe attack of pain in the abdomen which was not relieved by the medicine he was accustomed to take. From the onset of this last attack he had vomited everything he ate.

Physical examination was negative save for the abdomen, which was slightly rigid throughout and tender to deep pressure over the epigastrium, especially to the right of the midline. The temperature, pulse and respiration on admission were 99-112-26 respectively. The urine analysis was negative save for a trace of albumin. The leucocytes were 11,400. Laparotomy was performed May 27, 1922, and a duodenal ulcer was found which had perforated. The gall-bladder was freed from the mass of adhesions. The ulcer was oversewed. A posterior gastro-jejunostomy was performed and appendectomy done.

September 18, 1923, the patient was again admitted to the Howard Hospital, complaining of severe abdominal pain, but no nausea. Physical examination of the abdomen showed no distension or rigidity, but two points of tenderness, one below and to the right of the umbilicus and the other at a lower level and to the left of the umbilicus.

The temperature and pulse were slightly elevated. The leucocytes were 16,000. The urine analysis was essentially negative. A diagnosis of perforated jejunal ulcer was made and an immediate operation was performed. The jejunum was slightly enlarged, dull red in color and covered by a small amount of lymphatic exudate. A perforated ulcer was found opposite on the mesenteric border distal to the gastro-jejunostomy. This ulcer was oversewed and a second incision was made to the right of the first, exposing the pylorus which was obliterated by two sutures of kangaroo tendon.

An X-ray examination after discharge showed none of the opaque meal leaving the stomach by way of the pylorus. Following this second operation the patient was symptom-free for five years and held rigidly to his diet until the last few months of this period.

On the morning of January 29, 1929, he was seized with severe, agonizing pain in the centre of the abdomen which did not radiate. He went to work, however, and at the completion of his milk route the pain was still more severe. He was admitted to the University Hospital the evening of the same day. Physical examination of the abdomen at this time showed extreme tenderness throughout the upper abdomen being most severe in the left upper quadrant. Deep palpation was not especially painful. The abdomen showed very little rigidity, but the wall was extremely thin over the upper half of the abdomen. Peristalsis was diminished. Rectal examination was negative. The blood pressure was 140S-64D. There was slight elevation of pulse and temperature. The leucocytes on admission were 7900, but one hour after admission a second count was 11,400. The urine was negative. An X-ray examination failed to reveal the evidence of gas under the diaphragm.

Laparotomy was done by Doctor Eliason four hours after admission. The gastro-enterostomy site was examined and found to be functioning normally. An ulcer was found on the jejunum proximal to the gastro-jejunosomy. The loop of jejunum distal to the gastro-jejunosomy was firmly adherent to the proximal loop at the ulcer site and there was a kissing ulcer of the distal loop of the jejunum. The proximal loop was kinked and partially obstructed and there was dilatation of the gut above the obstruction. The distal loop was hypertrophic but not obstructed, and showed the scar of previous ulcer five years before. In an attempt to free the adhesions the jejunal wall was perforated at the point of ulceration. The ulcer of the distal loop was found to have penetrated to the serous coat. The ulcerated areas were excised with the cautery and a jejuno-jejunosomy was performed at this site. An area of calcification was found in the right rectus muscle.

The convalescence was complicated by a breaking down of the superficial tissues of the wound and a bilateral basal atelectasis.

SURGERY IN BREAST TUMORS

DR EDWARD J KLOPP pronounced the annual oration entitled "Surgery in Breast Tumors, Problems Concerning Diagnosis and Treatment," for which see p 424

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

STATED MEETING HELD APRIL 10, 1929

The President, DR FRANK S MATHEWS, in the Chair

CARCINOMA OF TRANSVERSE COLON

DR GUILFORD S DUDLEY presented a man who, in February, 1923, was admitted to the Second Surgical Division of Bellevue Hospital. He was then sixty-one years of age. He complained of intermittent cramp-like pain, in the lower half of the abdomen, of six months' duration. This pain had no relation to meals, although it was somewhat relieved by belching of gas. There had been no change noticed in his degree of constipation and no blood in his stools. The only other significant fact in his history was the loss of an indefinite amount of weight.

Examination showed a small, irreducible, umbilical hernia and a gastrointestinal series of X-rays showed a defect in the mid-portion of the transverse colon. The pre-operative diagnosis was carcinoma of the transverse colon.

Through a transverse incision, excising the umbilicus, an excellent exposure was obtained and a carcinomatous mass, one and one-half inches in length and one inch in diameter, involving the mid-portion of the transverse colon was found. There were no demonstrable metastases and no evidence of obstruction to the bowel lumen. The tumor, with one and one-half inches of healthy gut on either side of it, was removed and the continuity of the intestinal tract restored by a lateral anastomosis.

Convalescence was entirely satisfactory and he left the hospital on the thirty-second day after operation. Post-operative barium enema X-ray showed evidence of the anastomosis and a colon which filled without obstruction.

Pathological examination of the excised specimen showed it to be adenocarcinoma with some ulceration of the mucous membrane but without obstruction to the lumen. The tumor had extended entirely through the wall of the gut to the subserosal tissue, but sections of several large lymph nodes present in the adjacent fat showed only inflammatory hyperplasia.

His subsequent history has been one of continued improvement and gain in weight until the past five or six months. During this latter period of time, his diet has been restricted by his physician because of an elevated blood pressure, and the patient attributes his recent loss of weight to this cause. He has no symptoms referable to the intestinal tract and, as far as can be determined by physical examination, has no recurrence of the growth.

BILIARY DUCT LITHIASIS

DOCTOR DUDLEY presented, also, a man, thirty-seven years of age, who was operated upon seven years ago for gall-bladder disease. The record does not state whether or not his gall-bladder contained calculi at that time.

He was well until three weeks prior to admission to the Second Surgical Division of Bellevue Hospital June 15, 1928. At this time he began to suffer from a recurrence of biliary symptoms.

At operation his gall-bladder was found firmly embedded in a mass of inflammatory adhesions, but its walls were not thickened and it contained no calculi, nor were there any calculi in the cystic duct. Its size was approximately three times that of the normal gall-bladder and it contained normal-appearing bile. The biliary ducts were palpated and were found not to be dilated. No calculi were palpated within the ducts. His liver appeared normal. His gall-bladder was removed and the wound drained. For several days bile drainage was profuse, but other than this his convalescence was entirely satisfactory and he left the hospital twenty-three days after operation with a granulating wound which subsequently healed completely.

He remained well for about one month, but at the end of this time again suffered from upper abdominal symptoms and rapidly lost twenty-five pounds in weight. He did not become jaundiced nor did he give any history of chills, fever, or sweats. He was readmitted to the hospital and kept under observation for three weeks. During the first week there was a persistent fever of about 100° and tenderness over the lower portion of the operative scar. During the following two weeks his temperature remained normal. He showed no jaundice, his icteric index was 13, and X-ray examinations ruled out any lesion of the gastro-intestinal tract.

At operation the common and right hepatic bile ducts were found to contain an enormous accumulation of calculi. The common duct was opened and many, though not all, of these calculi were removed. Because of the patient's condition the operative procedure was terminated by the insertion of a fenestrated catheter into the hepatic duct for drainage and for the subsequent administration of bile to the patient.

His post-operative course was exceedingly severe. During the week that the catheter remained in place, a daily average of twenty to twenty-five ounces of bile drained through it. This was given back to him by means of a nasal tube into the stomach. Two weeks after operation he became deeply jaundiced and his icteric index rose as high as 40. Throughout his hospital convalescence, his jaundice and icteric index fluctuated considerably, but with a gradual general downward tendency. Similarly, his drainage of bile continued to be profuse, but also with a tendency to become less in amount. After removal of the catheter drainage a large number of biliary calculi were discharged through the wound. Many of these appeared to be casts of the smaller biliary radicals, others were distinctly faceted and the remaining material was of a granular, sand-like nature. Marked asthenia, an acute exacerbation of a chronic otitis media, and multiple furuncles were further complications. At the end of about three months, he began to show improvement and he was able to leave the hospital January 28, 1929, one hundred and twenty-four days after operation.

Since that time his sinus has discharged but one small calculus and its biliary discharge has diminished to a scant amount. Whether all of his calculi have been eliminated and the formation of further calculi ceased or whether he has reestablished a lumen through a duct filled with calculi as was the situation prior to his second operation, remains to be shown by his subsequent course. Because of the slight jaundice present before his cholecystectomy was done, it seems reasonable to assume that one or a few calculi within his ducts were overlooked at that time. The interesting feature of his case and the reason for his presentation to the society lie in the production of the enormous number of biliary duct calculi within a period of two months following the removal of his gall-bladder.

DR EDWIN BEER doubted whether the stones in Doctor Dudley's second case had reformed in the ducts, because Doctor Dudley had failed to open

the common duct and these stones may have been overlooked at the first operation. If the common duct were opened and found empty and in the post-operative drainage no stones had been discharged through the drainage tube, a reformation of stones in the duct system might have been considered as likely.

Of late there had been a number of cases in the literature purporting to be reformation of stones in the gall-bladder and in the hepatic ducts which do not bear close scrutiny. Reformation of stones in the gall-bladder is rare and reformation in the non-obstructed common duct leading into the hepatic ducts is also rare. With stone obstruction in the common duct and a mild degree of cholangitis stones seem to form readily behind the primary stone in the common duct and these stones may develop throughout the hepatic duct system, following six weeks' obstruction. The same type of rapid stone formation behind obstruction occurs in stagnant urine. Here, also, the occurrence is infrequent though more frequent than in the liver. Stones in the common duct may apparently be present for a long time without causing any symptoms and without inducing any secondary cholangitis with stone formation.

In a recent case, following an operation for kidney stone, the patient developed jaundice with high temperature. On investigation, it was found that the patient had eighteen years previously been operated upon for stones in the common duct, at which time some eighteen stones had been removed. On re-operation, eighteen years later, a solitary stone was found in the ampulla which was covered with brown bile salts and no other stones were present behind this stone. On breaking off the outer covering, it was found that the mantle covered a typical faceted stone. Apparently this stone had been left behind at the early operation and had caused no symptoms for eighteen years. From this and other experiences, it is evident that though stones are present in the common duct further stone formation behind these stones does not regularly take place though occasionally multiple smaller and larger stones may develop very quickly if the proper conditions are present in the duct system.

Doctor Dudley replied that there may have been a calculus present and he thought there was, because the patient was slightly jaundiced preceding the first operation, but there was not the massive collection of calculi present that there was at the second operation two months afterward. A great many were like casts of the smaller ducts and some were faceted.

SUTURE OF DISLOCATED ACROMIAL END OF CLAVICLE

DR RALPH COLP presented a man, forty-three years of age who was admitted to the Surgical Service of Dr Richard Lewisohn, Mt Sinai Hospital, May 7, 1928, after having been struck by a moving taxicab and thrown so that he landed on his left shoulder.

Examination at the time disclosed a spasm of the left trapezius muscle, localized tenderness and crepitus at the acromial clavicular articulation, and

a definite dislocation of the acromial end of the clavicle. The humerus showed no evidence of fracture. X-ray examination confirmed physical findings of dislocation.

Four days after admission, under general anæsthesia, the acromial clavicular articulation was sutured by open operation. An infraclavicular incision from the middle line of the clavicle to the acromion of the scapula was made. The acromial ends of the clavicle and scapula were freed of muscle, and the conoid and trapezoid ligaments were found ruptured. The acromial process of the scapula, and the acromial end of the clavicle, were drilled with two holes each, and sutures of kangaroo tendon were passed approximating both these bony structures, although they were not tied. A kangaroo suture was then passed under the coracoid process of the scapula and over the clavicle, and this was tied when the acromioclavicular joint had been reestablished by this suture. The sutures approximating the acromioclavicular joint were then tied. The trapezius and deltoid muscles were sutured over the joint, and the arm was placed in a Velpeau dressing reenforced by plaster. Eight days later the sutures were removed and a second Velpeau was applied.

Patient's shoulder was kept immobilized for six weeks, following which physiotherapy was instituted.

At the present time, the patient has a perfect anatomical and functional result.

Doctor Colp emphasized the point that the suture which is passed underneath the coracoid process really supplants the conoid and trapezoid ligaments until definite union takes place at the acromioclavicular joint. It has been found expedient in passing the suture under the coracoid to visualize the pectoralis minor by dissecting the pectoralis major from the clavicle. When this is done no difficulty is encountered in passing an aneurism needle under the coracoid process.

This method has been found quite effective in several other patients, and while the use of the fascia lata has been recommended in some cases, in our experience it has not been found essential.

STENOSIS OF THE COMMON BILE DUCT

DOCTOR COLP presented a woman, sixty years of age, who was admitted to Mt Sinai Hospital, June 4, 1928. For twenty years she had vague symptoms of indigestion. During the eight months prior to her first admission, she had had five attacks of typical gall-stone colic. She was first admitted to the hospital March 3, 1926. She was then emaciated, acutely ill, with a globular mass situated in the right upper quadrant of the abdomen over which there was rigidity and tenderness. Jaundice was definite.

At operation the gall-bladder was found buried behind the stomach and duodenum through adhesions. When these were separated, a pericholecystitis abscess was found. The gall-bladder itself was shrunk, acutely inflamed, and contained a single calculus. A mass of adhesions ran over the lower part of the gall-bladder, and in order to find the cystic duct the gall-bladder was opened, and in carefully peeling back the adhesions, the common duct was inadvertently opened transversely to about one-fourth of its diameter. The choledochus was then dissected free, probed, and found patent throughout. A cholecystectomy was performed. Troublesome hæmorrhage was encountered from what was supposed to have been the right hepatic vein. The gall-bladder bed was packed, a tube was inserted to Morrison's pouch, and one into the common duct.

Following the operation the patient reacted well, but after a few days she became intensely jaundiced and her temperature mounted, although there

INTESTINAL OBSTRUCTION WITH PERFORATION

was a free discharge of bile from the wound and bile was present in the stools. She evidently had an acute cholangitis.

The stools contained bile on repeated examination for thirteen days following the operation, after which they became clay colored and remained so until the date of discharge. The jaundice gradually disappeared, although her fistula persisted.

She was discharged on the thirty-eighth day, although it was felt the biliary fistula would be permanent, and would subsequently require transplantation into the stomach.

Two months later she was readmitted because of intense itching and she stated that two weeks after her discharge from the hospital her sinus had closed and she had become jaundiced again. When readmitted she was a markedly jaundiced woman. The abdominal examination was negative. The stools contained urobilin, the urine contained bile, and the van den Bergh reaction was positive, both direct, and indirect, 1 to 20,000. She was kept under observation for about one month and during this time her van den Bergh changed to 1 to 30,000, and bile again appeared in the stools. Upon her discharge, itching was still present and a diagnosis of inflammatory stricture of the common bile duct was made. She was then lost track of for two years when she again applied for readmission, that is on June 4, 1928, complaining of attacks of abdominal pain accompanied by nausea and vomiting, but what troubled her most was a generalized pruritus. At this time she was jaundiced. The abdominal examination was practically negative. The stools were clay colored, the urine contained bile, blood chemistry was practically normal, and the van den Bergh 1 to 70,000. At this admission, it was decided to perform an exploratory coeliotomy, and under spinal anaesthesia, supplanted by gas and oxygen, the previous incision was opened. After a very difficult and tedious dissection during which the duodenum was opened accidentally, and immediately sutured, the common duct was found stenosed by scar tissue, which extended from just above the duodenum to a little beyond the entrance of the portal fissure. The scar tissue was excised, the proximal and distal portions of the common duct were identified, and one end of a rubber tube was placed up in the right hepatic duct, and the other end passed through the ampulla into the duodenum. This tube was completely covered by fatty, connective fibrous tissues of the gastrohepatic omentum by a double layer of interrupted sutures and a rubber dam drain placed down to the suture line.

Following the operation the patient did unusually well. However, there was a profuse discharge of bile from the wound for ten days during which time the stools were completely clay colored although the jaundice was markedly diminished. Twenty-one days after the operation, the biliary drainage suddenly stopped, the stools contained bile, the blood bilirubin figures were normal. A flat plate of the abdomen taken at this time showed the rubber tube in place.

Some time in February, after an interval of six months, X-ray examination failed to disclose the presence of the tube in the common bile duct.

The patient has been well since her operation except for the recent development of some upper abdominal pain. She has gained thirty pounds in weight. Her itching has practically disappeared and she is no longer jaundiced. The stools and urine are normal.

INTESTINAL OBSTRUCTION WITH PERFORATION

DR RALPH COLP presented a man, twenty-nine years of age, who was admitted to the Mt Sinai Hospital, May 3, 1928. During July, 1924, he had

suffered from acute gangrenous appendicitis with pelvic abscess, for which an appendicectomy with pelvic drainage was performed. He ran rather an uneventful course until the eighteenth day when he developed signs of acute intestinal obstruction. Inasmuch as the original appendix incision was draining profusely, an incision was made in the left upper quadrant of the abdomen and a high jejunostomy performed. Following this, the intestinal obstruction was relieved, and the patient did well, although it took two weeks for the enterostomy to close following the removal of the tube.

After an interval of about a month, he was again admitted with signs of an incomplete intestinal obstruction, but following enemata and other medical measures the distention disappeared and he was discharged on the fourth day.

He remained well for three years when he was again admitted with an acute history of three days' duration, manifested by abdominal cramps, persistent vomiting and obstipation. He appeared acutely ill, although his pulse and temperature were normal. The abdomen was distended and tympanitic throughout, not tender. Rectal examination disclosed a high, firm, acutely tender mass about the size of an apple occupying the cul-de-sac and apparently not in the rectal wall. A flat plate X-ray taken at the time disclosed small intestinal distention. The blood urea was 22, blood chloride 5.1 gram, and blood dioxide 71 milligrams. He was given a hypodermoclysis of 1000 cubic centimetres of saline solution, and under spinal anaesthesia, the old appendix incision was reopened and the abdomen explored. The jejunal loops were markedly dilated. In the pelvis there was a mass of matted intestines glued together by dense fibrous adhesions. Separating these adhesions, an abscess was encountered which contained about eight drams of thick yellow pus, which, on culture, grew bacillus coli and streptococcus hemolyticus. An intestinal loop in this area was crossed by a firm, dense adhesion, evidently the cause of the obstruction, and just proximal to this was a small perforation, evidently the origin of the abscess. The remainder of the intestine, although covered with fibrin, was viable. The distal loops were collapsed. There was no evidence of any peritonitis beyond this local area. The band was divided and the perforation in the bowel was closed by purse-string suture, which was reinforced with a Lembert of silk. Because of the fact that the patient had had an intestinal obstruction, and the lumen of the bowel was narrowed because of the constricting band and the closure of the perforation, a lateral suture entero-enterostomy was performed between the dilated and collapsed loops of the intestine. The pelvis was drained by a tube and the wound closed in layers.

Following the operation, the patient was acutely ill for a few days and was given continuous intravenous of glucose, 5 per cent. The wound became infected and there was a marked fascial slough. Following this, however, he made an uneventful recovery.

Since his discharge he has been well, has gained weight, and there have been no untoward symptoms excepting a hernia from his operative wound.

This case is shown because it illustrates the fact that while a high jejunostomy relieves the intestinal obstruction, the actual cause of the obstruction may still persist and manifest itself years later, in this case after an interval of three years. Secondly, it shows that in selected cases, the internal drainage of the obstructed loops by entero-enterostomy is not only quite effective, but it presents a procedure of dealing with intestinal stenosis which is certainly to be preferred to a resection in those cases in which it is practical.

MESIAL EMPYEMA OF THORAX

MESIAL EMPYEMA OF THORAX

DR ALEXIS V MOSCHCOWITZ presented a patient, fifty-two years of age, who was taken ill October 12, 1928, with pleurisy. He ran a very high temperature in the beginning of his illness, which gradually came down to normal and then again rose and ran an irregular course. The patient's principal complaint was that of pain in the chest, more marked, however, in front and on the right side. Aspiration November 24 revealed the presence of pus. X-ray examination of the chest revealed a rather atypical picture on the right side. There was a dense shadow which extended from the hilus of the lung to within one and one-half inches of the lateral chest wall, and from the third rib to the ninth rib posteriorly. In addition to the above, there was to be seen another ovoid shadow extending from the diaphragm as high as the seventh rib in the axillary line. The X-ray department diagnosed a pleural effusion, though the possibility of a pulmonary neoplasm was also considered. In retrospect, it may be added that a positive diagnosis of a mesial empyema might have been made from the peculiar X-ray plate.

Operation November 27, 1928, under local anaesthesia. After preliminary aspiration, which again revealed the presence of thick, greenish pus, an intercostal incision was made, rather far back in the ninth interspace. Peculiarly throughout the entire extent of the rather long incision, pulmonary tissue adherent to the chest wall was exposed. Finally, the posterior margin of the lung was noted right near the vertebral column and when this was gradually released and retracted outward a cavity containing approximately 500 cubic centimetres of thick pus was entered and was drained by means of several drainage tubes.

The post-operative course was entirely uneventful. The cavity was dakinized in the usual manner, in spite of the presence of a demonstrable bronchial fistula. The patient was discharged on the fifty-second day after the operation with a small superficial granulating wound.

Mesial empyemata—that is, those bordered internally by the mediastinal pleura, anteriorly, by the hilus of the lung, and externally, by the visceral pleura—are to the speaker's mind of sufficient rarity to warrant presentation.

DR HOWARD LILIENTHAL said that a mesial empyema is very often overlooked. Median empyema is often characteristic of the secondary sacculization which may complicate ordinary empyema, and it should be noted that in the case just presented there was no deviation of the mediastinal structures, the heart was in normal position and the mediastinum perfectly straight. This is one of the diagnostic points. If one has operated upon an empyema of the usual kind and fever and signs of sepsis continue, and if the trouble, even with the aid of X-rays, cannot be found, one should immediately think of sacculations on the median side. Supraphrenic empyema is more apt to progress toward the median side than toward the lateral chest wall. In these cases it is very important that an early intercostal, generous exploration be made, lifting up the lower lobe from its adhesions to the diaphragm and exploring carefully toward the mid-line.

Just to illustrate how puzzling these cases may be, Doctor Lilienthal spoke of a patient, a young man, who had a general empyema and who developed a medial sacculization rather high up. An eminent medical consultant was called in by the family and, on examination, telephoned Doctor

Lilienthal he must operate immediately because the patient's heart was in the axilla and there was tense empyema of the right chest. Doctor Lilienthal heard the cardiac sounds in the left axilla but he questioned whether the heart was there. A roentgenogram revealed the heart in its normal position, as in the case of Doctor Moschcowitz. These mesial empyemata do exist, they are not particularly rare as secondary conditions and he thought this should be kept in mind by all surgeons doing work upon the chest.

TWO VARIETIES OF CARCINOMA IN ONE LOBE OF THE THYROID GLAND

DR ALEXIS V MOSCHCOWITZ presented a man, forty-six years of age, who had always been in good health and who consulted him for a swelling occupying the left side of the neck. It had existed for about four months and it increased rather rapidly in size, and there was some difficulty in swallowing for the past month. On physical examination there was found a tumor, the size of an egg, which occupied the left lobe of the thyroid gland. The major portion of this tumor imparted to the examining finger a rather cystic feel. The lower and mesial part of the tumor at quite an appreciable distance from the previously described mass, and separated from it by apparently normal thyroid tissue, was much smaller than the former and so hard that the diagnosis of carcinoma of the thyroid was made without reservation.

The patient was operated upon November 27, 1928. Exposure in the usual manner and ligation of both the left superior and inferior thyroid arteries. As the lobe was being enucleated, the previously-mentioned large tumor was accidentally broken into and a rather soft and grumous material escaped, which, on frozen section by Doctor Klemperer, proved to be a papillary cystadenocarcinoma of the thyroid. With this assured diagnosis the entire lobe and isthmus were extirpated. The specimen, subsequent to removal, showed a second isolated tumor near the tracheal attachment of the thyroid gland, which on microscopic examination proved to be a scirrhous carcinoma.

The patient made an excellent recovery and was discharged healed fifteen days after operation. Since his discharge, he has received radiotherapy and thus far is in good health.

Doctor Moschcowitz presented this case on account of the rarity of the condition, namely, two separate and differing carcinomata in one lobe of the thyroid.

DR CHARLES GORDON HEYD said that about two years ago he presented before the society a case of carcinoma of the thyroid which had a scirrhous carcinoma on the right side and an adenocarcinoma on the left. The interesting feature of the case was the fact that the malignancy on either side could not have had a common origin. The carcinoma on the left side had grown downward and backward behind the carotid sheath so that the carotid artery on the left side was anterior to the tumor. Pearson in England, had brought out that most of the carcinomata of this type had sprung from the ultimobronchial rest and were not, strictly, part of the thyroid until later growth incorporated them with the thyroid gland. The degree of malignancy varied very markedly. In the ordinary cystadenocarcinoma the expectation of longevity was fair, whereas the scirrhous infiltrated carcinoma was progressive and

TYPHOID INFECTION OF THE COSTAL CARTILAGES

later invaded the trachea and oesophagus. This was the ultimate outcome of the case presented before this society by Doctor Heyd

DR MOSCHCOWITZ rejoined that in the particular case shown, there was no displacement, as the entire left lobe of the thyroid gland was situated in front of the carotid artery

TYPHOID INFECTION OF THE COSTAL CARTILAGES

DR ALEXIS V MOSCHCOWITZ presented a man, forty-three years of age, who had typhoid fever in December, 1924. In May, 1925, he noticed a rather painful swelling over the lower part of the right anterior chest wall. In the course of time, the skin perforated spontaneously and discharged pus. An X-ray examination at that time was negative. He reentered the Norwegian Hospital and was operated upon for this condition three times, approximately in September and December of 1925, and in February, 1926, and also received diathermy. Subsequently, he entered Mt Sinai Hospital and was operated upon twice, August 20 and December 24, 1926. The first operation consisted of a thorough removal of the cartilage of the involved seventh rib, from its junction with the osseous part of the rib into the sternum. A discharging sinus again formed, whereupon the patient was again operated December 24, 1926. This operation was similar to the preceding one, but in addition, the entire xiphoid appendix was extirpated and the end of the adjoining costal cartilage of the left side exposed and divided. He left the hospital one month later with a discharging sinus and with this condition he came into the reporter's care in November, 1927. The diagnosis was perfectly clear, namely, typhoid chondritis, and the indications, also perfectly clear, namely, the removal of the entire mass of cartilage of the sixth, seventh, eighth, ninth and tenth ribs on both sides.

Although he had intended to do both operations at one sitting, the first operation, November 12, 1927, owing to the numerous preceding operations, was so difficult and of such long duration, that when he had finished the right side, he deemed it best to postpone the operation upon the left side for a future time. Because of the infection, this wound was left wide open. Following the first operation, the patient developed a complete bilateral brachial plexus palsy. It was accounted for by the position of the arms upon the operating table, which was thought to be necessary because of the site and the extent of the operation.

The second and final operation took place December 7, 1927. This consisted of the extirpation of all of the cartilage of the sixth, seventh, eighth, ninth and tenth ribs on the left side. At the termination of the operation, no cut surface of cartilage was to be seen anywhere. This wound was sewn up completely with very slight drainage by means of a small tube and primary union resulted. The patient was discharged healed in fifty-nine days after his first operation and has remained healed ever since that time.

DR NATHAN W GREEN referred to a case in his service at the city hospital in which he thought the infection of the costal cartilages was due to tuberculosis, but was unable to differentiate between tuberculosis and typhoid. The man gave a history of typhoid some years previous. Doctor Green had effected a complete cure of the condition by merely taking out the cartilages on the left side, but it left the apex beat rather exposed. The patient did not seem to suffer any deleterious effect from this operation except that the expo-

sure of his heart worried him because it seemed unprotected. He wore a heavy leather pad over it afterward which seemed to reassure him.

Doctor Moschcowitz stated that it had been his experience in a number of cases that the costal cartilages redevelop rather well, though somewhat irregularly after they have been extirpated subperichondrially. In the particular case shown tonight, the hiatus is already filled in by cartilage.

FRACTURE DISLOCATION OF THE CERVICAL SPINE

DR ALFRED S. TAYLOR read a paper with the above title, for which see page 321.

STATED MEETING HELD APRIL 24, 1923

The President, DR FRANK S. MATHEWS, in the Chair

SKELETAL TRACTION FOR SEPARATION OF LOWER EPIPHYSIS OF FEMUR

DR JOHN J. MOORHEAD presented a boy, sixteen years of age, who was first seen by him at the Passaic General Hospital April 21, 1927, with Dr G. J. VanSchott, Jr. Ten days prior he had been struck by the bumper of an automobile and had sustained an epiphyseal separation of the lower end of the femur, with such a marked displacement that the condyles and the patella lay anterior and on a level higher than the fracture. Several unavailing attempts had been made under an anæsthetic and by continued traction to reduce the deformity, a transfixion pin was finally introduced in the neighborhood of the head of the tibia just below the level of the tubercle, and a weight of twenty pounds was attached to the flexed limb. Within twenty-four hours X-ray examination showed beginning replacement. Eight days after the skeletal traction had been started the reduction was complete. The weights were gradually reduced and finally removed, with the transfixion pin, May 10. X-ray June 1 showed firm union. The transfixion wounds were then healed. He remained in the hospital until June 14 and at that time there was motion in the knee from full extension to about sixty degrees. He was seen by the reporter December 1, following. At that time he had a slight limp. There was no shortening but there was some adduction of the knee and flexion of it amounted to about 100 degrees. Now, two years after injury, the extremity appears normal aside from the fact that he lacks fifteen degrees full flexion.

The efficacy of skeletal traction where other means fail is again justified in this instance. An interesting and important feature here is that there has been no interference with the growth of the limb, probably due to the fact that this patient was at the time of his injury sixteen years of age and that epiphysitis at that age-period apparently is not as serious a growth deterrent as it appears to be earlier in life. In another almost identical case in a younger boy, transfixion was used successfully after the lapse of several days. In this case, however, epiphyseal damage was evident and the growth of the limb was impaired. That, however, is in no manner ascribable to the transfixion.

ARTHROTOMY FOR HYPERTROPHIC OSTEO-ARTHRITIS

DR JOHN J. MOORHEAD presented a man, forty-two years of age, with the following history. He was first seen January 17, 1927. His right knee-joint trouble began twenty-six years ago following a football accident. It was stated at that time that his cartilage had been displaced. He wore a brace on the knee for three years and the joint "went out" at intervals after slight exertion. This, however, ceased some six or eight years ago. The joint has

MOTOR-DRIVEN DEVICE FOR FRACTURES, ETC

been continuously weak, swollen painful and it always showed limitation of motion, particularly in extension. He sought relief for his continued dysfunction and pain and also because he was becoming bow-legged. For years he had been unable to lie on that knee. The joint was swollen particularly in the region of the head of the tibia. There was audible and palpable crepitus. There was apparently a definite bony overgrowth on the inner margin of the femur and a corresponding portion of the tibia. Motion was from 165 extension to 105 flexion.

May 23, 1927, at the Post-Graduate Hospital, a medio'ateral arthrotomy was performed and at that time the diagnosis of osteo-arthritis was verified and it was also noted that the internal semilunar cartilage had been almost completely eroded in its central part and that what remained was curled and irregular. The subpatella fat pads were markedly increased and one pedunculated pad had a cartilaginous calculus. The osteophytes were removed together with the hypertrophied fat pads, synovia and damaged internal semilunar. In the after care, immediate active motion was employed. There was very little post-operative reaction.

September 26, 1927, he reported that the knee was free of pain and that he could make it do whatever he wanted. His improvement has continued up to the present, and he now has practically perfect function.

The reporter recalled to the society that in November, 1925, he read a paper with the title "Arthrotomy for Knee-joint Calculi" and at that time reported forty-nine cases. Accumulating experience has justified the prediction then made that the surgical knee by comparison with the medical knee was just as definite an entity as the surgical abdomen by comparison with the medical abdomen. At the present time the mediolateral approach is the operation of choice. The surgeon no longer makes the small incision except in young persons who give a very definite history of recent trouble, especially for athletes who have definite signs of semilunar injury. The ultra-aseptic Lane technic is used throughout. He was firmly convinced that there is a wide field for arthrotomy to relieve knee-joint dysfunction in non-traumatic cases and in those reawakened into activity by a more or less distinct trauma. He had now a series of 122 knee-joint arthrotomies, many of which were performed for osteo-arthritis of this same deforming and disabling type.

MOTOR-DRIVEN DEVICE FOR FRACTURES, DISLOCATIONS AND STIFF JOINTS

DR JOHN J MOORHEAD remarked that in the May, 1928, issue of the *American Journal of Surgery*, he published an article entitled "Setting Fractures by an Electromotive Device," in which were stated some recent experiences with a device called the "Articulator" which is a non-portable, motor-driven device with moving arms. A harness or strapping can be attached to any limb and in turn this is fastened to one of the arms of the machine and counter traction is applied to the other arm of the machine. When the apparatus is set in motion a definite pull and let go is provided. The amount of the pull in pounds and the length of the stroke, and to some extent the speed, can be controlled. It will thus be seen that the apparatus is in effect a motorized fracture table, differing in that the pull can be regulated and it is intermittent. Recognizing that this pull and let go principle was useful in the reduction of fractures and dislocations, he tried out the machine with enough success to believe that a somewhat simplified piece of apparatus would have a field in fracture service.

The device now presented does all that the "*Articulator*" did and in addition is portable, so that it can be brought to the patient anywhere that electricity is available. The present experimental apparatus weighs sixty-five pounds, is thirty-five inches long and seven inches high. A universal motor

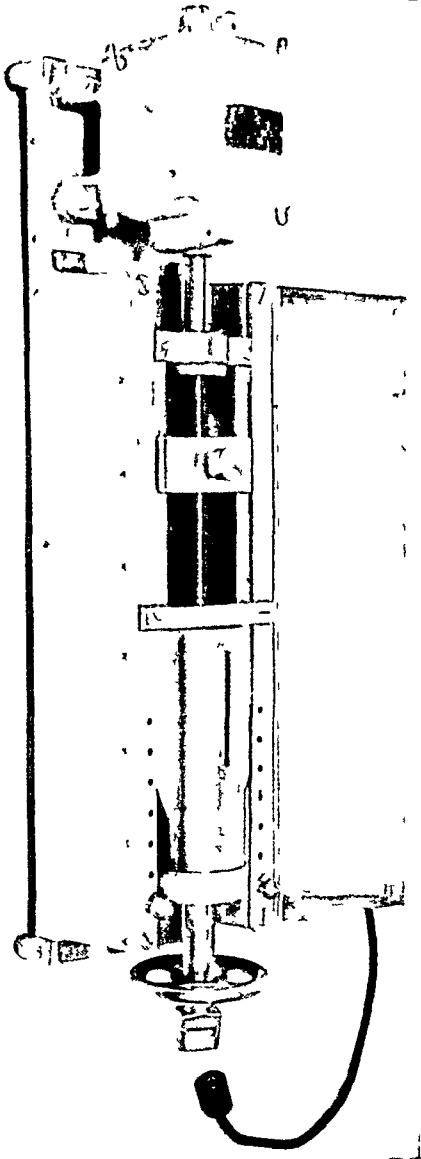


FIG. 1.—Device for manipulations required in the treatment of fractures, dislocations and stiff joints

will be provided so that it can be used with direct or alternating current. In final form the weight will be reduced to about forty-five pounds. The advantages of a machine of this sort are apparent when it is realized that no fracture or dislocation is in reality set by setting the bone, but rather by setting the muscles and tendons which keep the bone in a distorted position. Any form of intermittent traction will act better on elastic muscles and tendons than continuous traction. For the relief of stiff joints, intermittent traction is of course a well-established principle. He had found in his short experience with the apparatus that he could obtain traction up to ninety pounds and that he could manipulate the fragments in a fracture after they had been distracted during the period when the machine is in a period of diastole. His practice is to gradually increase the pull until he has obtained very free crepitus and very free false motion and then stop the machine in a period of contraction and mould or manipulate the fragments, and if they apparently lock, then relax the tension and apply splintage. The ideal way of course is to do this under the fluoroscope, and in certain fractures it is possible to apply a circular plaster-of-Paris casing down as far as the fracture, then to leave a gap over the fracture and apply plaster on the rest of the limb. When the

fracture has been aligned, the gap between at the fracture site is then filled with plaster and the casing is complete.

LONGITUDINAL FRACTURE OF THE PATELLA

DR JOHN F. CONNORS presented a man, who, February 20, 1929, slipped and fell to the floor, striking his left knee. He was able to walk and had no pain or swelling. One hour later there was severe pain in the knee and he

AVULSION FRACTURE OF THE CORACOID

was able to flex his leg only slightly. Slight swelling was present, no redness. An X-ray, taken in the usual positions, showed no signs of fracture. The following day the swelling had disappeared. On the third day the knee began to swell and upon measuring, the injured knee was one and one-half inches larger than the other. Another X-ray revealed nothing. There was no pain and at the end of this day the swelling again disappeared. On the fifth day the swelling reappeared accompanied by some pain, but with no loss of function, except that he was not able to go upstairs with his left leg as well as with his right. At this time a stereograph was taken which revealed a longitudinal fracture of the patella (Figs 2 and 3). The knee was strapped diamond-shaped with plaster, the patella being left uncovered. He has completely recovered his function and has slight pain on stormy days, not at the joint but about two inches above in the quadriceps tendon.

Scudder says that longitudinal fractures of the patella occur and should not be overlooked. A recurrent joint effusion, such as occurred in this case, would suggest the true condition. Stimson passes it over with this statement: "Vertical fractures are due to direct violence and rarely show much displacement."



FIG 3—Longitudinal fracture of the patella
Knee bent



FIG 2—Longitudinal fracture of the patella
Leg straight

Roberts and Kelly, in 1921, reporting 1400 fractures, of which fifty-five were of the patella, saw no cases, but in a later issue they describe two cases.

The speaker was of the opinion that in many instances these cases are overlooked for the reason that it is difficult to show by the X-ray, particularly when there is much effusion. The best picture of this case was made by flexing the knee and placing the plate at the lower border of the patella, the X-ray passing from above downward.

AVULSION FRACTURE OF THE CORACOID

DR JOHN F. CONNORS presented a man, thirty-eight years of age, who was injured in an automobile accident. He was thrown from his seat striking his

right shoulder. Immediately after the injury he had severe pain with complete loss of function. He was taken to a hospital in another state where he was X-rayed and a diagnosis of fracture of the right humerus was made. His arm was strapped to his right side with a pad in the axilla and it was kept in that position for four weeks. When the strapping was removed the function was in no way improved and any effort to use it caused a great deal of pain. Seven weeks following the injury he was able to resume his duties as a house cleaner, but the return of function was a very slow process.

March 13, 1929, he came to the clinic at Harlem Hospital, complaining of stiffness in the right shoulder with limited range of motion but not enough to prevent him from working as a house cleaner. Examination on this date showed that the prominence of the right shoulder was considerably decreased, no peri-articular tenderness, abduction of the right humerus to an angle of about seventy-five degrees, external rotation about fifteen degrees and internal rotation about forty degrees. An X-ray taken on this date revealed an avulsion fracture of the coracoid.

Since that time the patient has been receiving physiotherapy. At present the range of motion is practically normal and he is able to attend to his regular daily duties.

It is obvious that in this case the dislocated coracoid process was mistaken for a fracture through the greater tuberosity of the humerus. In searching the literature there is little said of this condition, although Speed says it is not uncommon and is caused by direct violence, such as by tackling in football and muscular action. Perhaps some of these cases of avulsion fracture of the coracoid have been treated for a fracture of the greater tuberosity of the humerus, but Cotton says in the "*Archives of Röntgenology*" for October 1919, "that fractures of the greater tuberosity of the humerus are rare." This case serves as a good illustration of conservatism and shows that anatomical position is not essential for obtaining function at or near joints.

DR RALPH COLP said that in July, 1928, a man was admitted to the Beekman Street Hospital, who had fallen from a scaffold and landed on his shoulder. He treated himself for two days, but finally came to the hospital with his arm held in absolute abduction and no motion in the shoulder-joint. X-ray showed a fracture at the base of the coracoid with a rotation of the process of about ninety degrees, the tip of the coracoid being pulled downward and inward. He was at first treated in abduction, but inasmuch as the pain persisted and the fragment remained rotated, it was deemed advisable to remove the coracoid. This presented no great technical difficulty. Following the operation the arm was kept in abduction for a period of two weeks when active motion was instituted. He was then lost sight of for a period of six months when he was seen in the Follow-Up Clinic. His functional result was poor and there was marked limitation of all motion at the shoulder-joint, although there was no pain. X-ray taken at this time showed that the conoid and trapezoid ligaments were calcified and, in addition, there appeared some calcification of the other muscles. In the experience at the Beekman Street Hospital, fractures of the coracoid are extremely rare. In fact this is the first case ever noted there. Doctor Colp felt that if there were any cases in the future, the conservative method would be more conducive to better results than the removal of the body of the coracoid.

LIPOBLASTOMA OF THE NECK

DR E W PETERSON presented a child now about three and one-half years of age. He was born at the ninth month of gestation, the labor was normal, birth weight was six and three-quarter pounds. The infant cut his first teeth at five months, sat alone at seven months, talked and walked at twelve months of age. At about two years of age, following an attack of acute coryza, there developed a swelling just back of the angle of the jaw, on the left side, which apparently involved the left parotid gland. A diagnosis of mumps was made at this time. However, the swelling did not disappear, but increased in size, and after six weeks the child was sent in to the Babies' Ward of the Post-Graduate Hospital with a diagnosis of "cyst of the parotid gland." At no time was there any pain, redness or evidence of acute inflammation. The

LIPOBLASTOMA OF THE NECK

general examination was negative except for the large swelling of the left side of the neck with a bulging forward of the left lateral pharyngeal wall. There was a single small gland on the right side of the neck, and small palpable glands in the axillary and inguinal regions. The tumor of the left side of the neck seemed to be made up of a conglomerate mass of soft glands. Hodgkin's disease and lymphosarcoma were considered in the efforts to make a diagnosis. The spleen could not be palpated, the liver was not enlarged and an X-ray examination showed the chest to be normal.

Biopsy and frozen section examination of the tissue was done February 23, 1928. An oblique incision was made over the tumor and an encapsulated growth was removed without any difficulty. It appeared to be a lobulated lipoma.

The pathological report by Doctor Alter is as follows:

Microscopic—Section shows a very cellular growth*. The cells show malignant features as far as shape and size of cell are concerned. Most of the cells are polyhedral with a granular protoplasm and small nucleus. A few of the cells have the typical signet-ring shape. There are frequent mitotic figures.

Diagnosis—Lipoblastoma of the neck.

DR EDWIN BEER said this case was practically an embryonal fat-cell tumor. Doctor Symmers has described some of these cases, and others are found in the French literature. One of these cases he had been observing for a long time, the first operation having been done in 1916 for a large, lobulated lipoma in the right popliteal space. This tumor was fairly well encapsulated, though these embryonal fat-cell tumors are not usually so. It was thought the tumor was removed completely. In 1922 a recurrence had developed in the right popliteal space and a large lipoma had developed at the base of the neck on the right side. Both these were removed. The next lipoma that was noted was a large tumor in the right inguinal region, partly superficial and partly intramuscular. In 1924 the popliteal tumor had recurred and was removed, at the same time, a tumor in the right inguinal region was also removed. At this time it looked as if there were a small recurrence of lipoma that had been removed at the right side of the neck. The popliteal tumor at this operation was found to be arborescent, running in between the various structures of the popliteal space and the adjacent muscles. At one place it seemed to infiltrate between the fibres of the muscles. The patient was given X-ray treatment, but despite exposure of the various areas to X-ray, in 1927 she returned with a small lipoma in the opposite popliteal space and a large lipoma in Scarpa's triangle on the left side. The recurrence in the neck was definitely larger and the right popliteal space was free. At this time she also complained of girdle sensation about the lower dorsal region, and later developed transverse myelitis. She was operated upon for this condition, and the embryonal fat-cell tumor was found pressing upon the cord extradurally and running into the intervertebral foramina on the left side (C. Elsberg). The lipoma in and about the spinal cord recurred. The patient finally died after a third spinal operation in 1928.

* This growth would recur if any of the capsule is left behind. They may be multiple in this neighborhood and may recur from other remnants. They do not usually metastasize.

MULTIPLE RESECTIONS FOR CHRONIC OSTEO-ARTHRITIS

DR HENRY H M LYLE presented a woman who, at the age of thirty-one, entered his service at St Luke's Hospital, in April, 1924. She was a

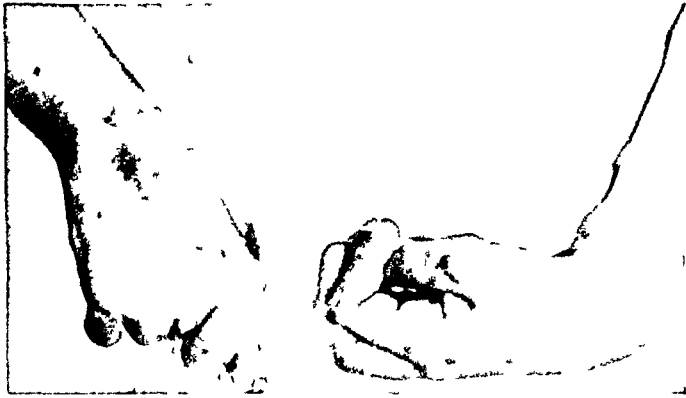


FIG 4—Wrist and fingers ankylosed. The left thumb is fixed in the palm. The right is ankylosed and is forcing the ankylosed index toward the ulnar side.

poorly nourished female showing the typical lesions of a long-standing ankylosing polyarthritis. She was helpless and practically bedridden. She could not feed herself or take care of the ordinary toilet necessities of life. Thirty years ago, when this patient was six years old, she apparently had a severe attack of Still's disease. The first joints to be involved were the proximal interpha-

langeals, then the metacarpophalangeals, the wrists, elbows, shoulders, cervical spine, knees, hips, lumbar spine, etc. Although the involvement was symmetrical and assumed the usual centripetal advance, the joints of the right side were attacked first.

The conditions of these structures and the problems to be solved are best shown by the accompanying photographs and radiographs (Figs 4-II). The joints are ankylosed in various unphysiological positions and with the exception of the hip and knee, ankle, and shoulder all the joints have been completely destroyed. The medullary canal of the humerus passes directly into the canal of the radius and ulna and these latter into the carpals, and the medullary canals of the metacarpal pass into the phalanges.

It was decided to attack the joints of the left arm in the following order: Wrist, fingers, elbow, shoulder and the right thumb. The patient's poor general condition made the ultimate result doubtful and we considered it better judgment not to depress her general morale by rendering both arms helpless at the same time.

April 26, 1926, a combined partial resection and arthrodesis of the left wrist was performed, the wrist being fixed in 30 per cent dorsal flexion. In addition, an arthroplasty of the first metacarpophalangeal joint was performed, overcoming the contracture and freeing the thumb from the palm. After stabilization of the wrist a ring extension splint was worn to overcome and stretch the flexor tendons. A fair grasp for light work was obtained.



FIG 5—Anteroposterior view of left wrist. Note ankylosed position of thumb and joints of wrist and hand.

and the patient, for the first time, was able to write, sew, etc. This proved to be a great joy to her.

The patient returned the following spring and a *MacAusland arthroplasty* of the left elbow was performed. Fascia from the thigh was used as the interposing membrane. Some doubts regarding the use of fascia in this case was entertained on account of the very poor nutrition of the surrounding structures.

Five weeks after the operation some of the fascia sloughed and had to be removed. Judged by ordinary methods a good functional result was obtained, but as her cervical spine was fixed and she could not flex her head, some difficulty was experienced in reaching the mouth. The change in her general condition was most striking for with the increase of the functional use of the hand and arm came a marked increase in weight and muscular power. The biceps which had been a mere thread now could be felt. She stated she was ready for anything. March 19, 1928 a partial resection and arthrodesis of the right wrist was performed. March 28, 1928, an arthroplasty of the right elbow was performed through Langenbech's posterior incision. The ends of the bones were carefully moulded and eburnated by filing with fine wood-carvers' files. On account of his experience in the left



FIG. 6.—Lateral view of left wrist. A similar condition is present in right wrist.

elbow and in other cases of this nature the fascial covering was deliberately omitted. His faith in simple eburnation was justified. The patient was so pleased with the functional results that she demanded that she be given as good a left elbow as the right so January 15, 1929, the left elbow was revised. Through a Langenbech's incision the joint cavity was opened and it was found that the remaining fascia had formed dense connective tissue adhesions. These were excised and the articular ends of the bones carefully eburnated. All resections of the elbow were preceded by manipulation of the shoulder. After resection of the elbow the arm was placed in a Thomas splint with suspension and traction in the abducted position. As a result she has obtained the full range of flexion, one might almost call it hyperflexion. Note her strong extension. In order to get out of bed or a chair she has to put

her full weight on her elbow-joints This proves conclusively their stability Further work is in progress on the small joints of the hand

The patient, thanks to her intelligence and will power, has now become a wage-earning member of the community She has contributed stories to one of our best magazines and now has had a scenario accepted

IMPAIRED SHOULDER FUNCTION

DR DONALD GORDON read a paper with the above title, for which see page 341

DR ROBERT T MORRIS asked Doctor Gordon how he classifies impaired function at the shoulder-joint occurring after amputation of the breast After these patients have suffered for a certain length of time adhesions have been found which require breaking up, but there is a limitation of movement which has no relation to the loss of muscle One other point where there are sec-

ondary changes with perhaps adhesions with a roughening of the cartilages or lessening of the synovial fluid, as is often seen in septic changes with gonococcus or streptococcus infection at the shoulder, a good

plan is to inject a lubricant that



FIG 7.—Left elbow showing bony ankylosis Note that medullary cavity of humerus connects directly with those of the radius and ulna A similar condition is present in right elbow

remains for a long time Doctor Morris uses one ounce of boroglyceride, three ounces of glycerine and four ounces of Ringer solution, or isotonic saline solution, in an eight-ounce mixture It is hygroscopic and draws toward itself interstitial infiltrates of tissue about the joint so that inflammatory pain may be relieved immediately or very promptly, sometimes within an hour in an old painful knee-joint In the shoulder two or three or four drachms may be injected but only a few drops for a carpal articulation The knee-joint will sometimes take more than an ounce of this artificial synovial fluid

DR WALTER M BRICKNER criticised Doctor Gordon's description of the stiff shoulder that is sometimes left after a Colles's fracture as a non-traumatic, extra-articular lesion that results from the patient's effort to immobilize his forearm by splinting the shoulder This shoulder stiffness is not at all common in association with Colles's fracture and in Doctor Brickner's experience, individuals with fractures at the wrist do not splint their shoulders The occasional stiffness of the shoulder has been clearly described by Sir Robert Jones as an injury to the joint, a subacute traumatic arthritis or,

IMPAIRED SHOULDER FUNCTION

as Jones has also called it, "stubbing of the shoulder," occurring coincidentally with the Colles's fracture by transmission of the force to the shoulder-joint when the individual falls upon his outstretched arm

Doctor Gordon has said that the shoulder disability that remains after the subsidence

of the pain of an acute subacromial bursitis is due to muscle contracture

Doctor Brickner thought that this is not the entire explanation In these cases adhesive bursitis and supraspinatus ten-

donitis (the underlying lesion) are still present after the subsidence of the acute symptoms More often the converse picture obtains, namely, that pain,

especially on certain motions, persists after full motion has been restored

It is commonly believed and taught that in unaffected shoulders the scapula does not begin to move in abduction until the arm is elevated to a right angle with the body In Doctor Brickner's experience this varies with different individuals and it is not uncommon to find the scapula participating



FIG 8—Condition of hand after multiple resection of metacarpophalangeal and interphalangeal joints



FIG 9—Functional result after resection of both elbows

in abduction when the arm is raised about 70° or even less

In describing the structures and the mechanics concerned in the shoulder, Doctor Gordon very clearly emphasized the importance of abduction in the treatment of, especially, peri-articular lesions and of joint fractures, both in the prevention and in the cure of shoulder disability Sir Robert Jones, too, reminds us that the muscles attached to the upper end of the humerus spread out fan-like or cone-like to the shoulder girdle and chest, and when the arm

is abducted to or just beyond a right angle, the resultant pull of all these muscles is in the axis of the humerus, but if the arm is allowed to occupy a position nearer the body there is cross torsion by some of these muscles

On the importance and value of abduction in the treatment of many shoulder conditions, there should be entire agreement with Doctor Gordon. Various methods are employed to secure this abduction, and very commonly used is fixation at right angles in an aeroplane splint or plaster case.



FIG. 10—Superimposed photograph showing range of movement at elbow

In the treatment of both acute and chronic subdeltoid (subacromial) bursitis, of other varieties of peri-arthritis of the shoulder, of fracture of the greater tuberosity and even in many cases of fracture of the anatomical or surgical neck of the humerus

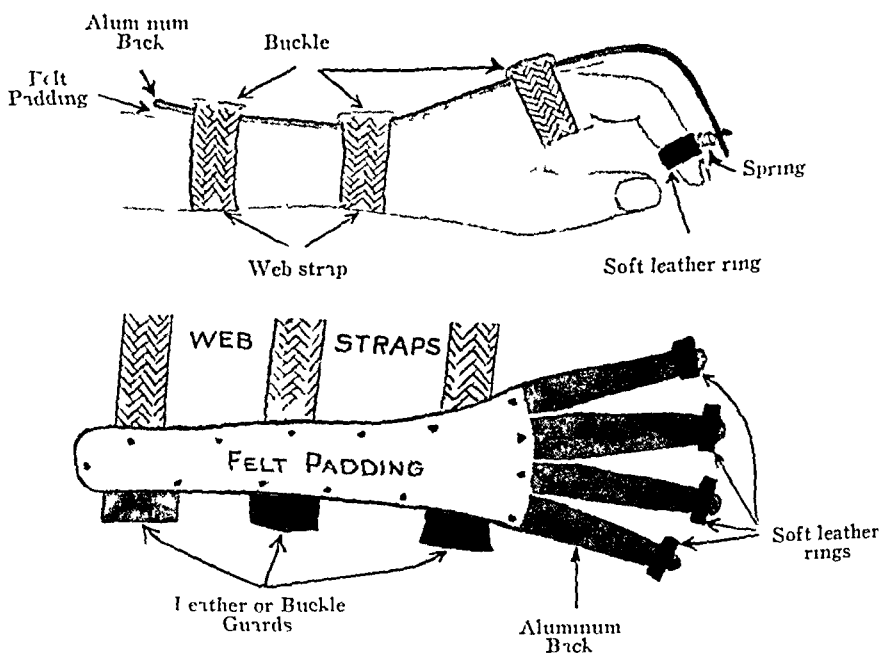


FIG. 11—Drawing made by the patient of the splint worn by her to exemplify the functional use of her hand

Doctor Brickner has found quite the most satisfactory abduction procedure, that method which he described some years ago—a non-immobilizing, automatic and easily regulable abduction in bed. With the patient recumbent upon an incline of pillows he abducts his arm as far as he can comfortably and without pain. In this position it is supported by small pillows and by

IMPAIRED SHOULDER FUNCTION

a simple sling of gauze or toweling fastened to the head of the bed. The recumbency itself relaxes much of the spasm and often passive or even active abduction is considerably greater lying down than when the arm is dependent. As the patient slips down in bed the arm goes up, and very often in cases of shoulder disability in which abduction has been limited to a comparatively small arc for many months the arm is found up alongside the head even in twenty-four or forty-eight hours. The sling can be slipped off and the arm brought down whenever the position becomes irksome or painful, and the treatment may be employed for short periods night and morning in individuals who are unwilling to remain in bed during the day. The method has the advantages of great simplicity and the avoidance of immobilization of the joint. When abduction has been thus restored it is maintained, and internal rotation is also restored, gradually, by means of a simple exercise with a light Indian club.

Doctor Brickner believes that subdeltoid bursitis is not infectious or toxic but it is traumatic in origin, due primarily to injury to the supraspinatus tendon. Not uncommon, however, is a monarticular arthritis of the shoulder, probably due to some low grade of infection, which is not infrequently mis-treated for subdeltoid bursitis. It may be put down as axiomatic that if the joint cannot be moved in any direction the lesion is intra- and not merely peri-articular.

Doctor Brickner agreed entirely with Doctor Gordon in the value of local heat, especially in helping to relax muscle spasm, and also in the observation that diathermy is very disappointing. In determining the value of any form of physical therapy it must be remembered that peri-arthritis of the shoulder of various types often subsides spontaneously.

DR JOHN J MOORHEAD said that next to back cases, shoulder cases give the most trouble from the standpoint of diagnosis, quite as much as they do from the standpoint of treatment. Doctor Gordon has illustrated a great many practical points of the treatment. He also rightly lays a great deal of stress on gentle massage and gentle active motion. Doctor Moorhead believed a great deal of harm is frequently done, although unwittingly, when an order is given for baking and massage, this should be supervised by the surgeon instead of sending the patient to the physiotherapy technician. A number are reactivated by rough massage and usage. In his own cases he has found that the combination of dry and moist heat, massage, and gradually regulated motions, without any other form of physiotherapy are usually sufficient. Diathermy was disappointing. Of all forms of physiotherapy, return to some form of work was the best physical and mental stimulant.

DOCTOR GORDON, in closing, said that his only answer to the kindly criticism was, that this has been based on his personal experience with shoulders, and the more he sees of them, the less he knows. The paper was written merely with the idea of passing on to some of the younger men some of his difficulties. He felt that when a patient came to his office with a shoulder, he wished he could get rid of him some other way.

In regard to Doctor Morris' question He was trained to strap the arm of the mastectomy case close to the side of the body with the forearm across the chest He does this still until there is no tendency to a painful reaction on abducting the arm The time for this varies and is proportionate to the individual's reaction, tension of sutures, and degree of healing The time necessary is from six to ten days The arm is then loosened and an axillary pad and sling are used which gradually afford room for movements of necessity Then the patients are instructed to proceed with the other exercises before atrophy of disuse develops If movements are instituted too quickly on breast cases, he believes they develop a protective spasm, and in turn contracture

He was speaking of extra-articular lesions and not intra-articular ones He has not injected any joints

In answer to Doctor Brickner's question This was only his personal experience He believes that in the mechanism of production of a Colles's fracture, there is an injury which can take place at the shoulder, but what he speaks of is not that type, but one where the painful fracture is improperly splinted Doctor Gordon said he was acquainted with Doctor Brickner's method, but in the cases he has tried it on, he could not get the patient's arm up far enough on account of pain It was purely a matter of a simple procedure for which he had not the proper technic, although it will probably work, and is a very essential technic with which to be familiar

In regard to subacromial bursitis being toxic He has seen them clear up without manifest focal infection, and he has seen them develop and rapidly clear up with little treatment upon removal of focal infection

BRIEF COMMUNICATIONS

WALLED IN APPENDICEAL ABSCESS IN AN INFANT EIGHT MONTHS OF AGE

ARTICLES on appendicitis in children emphasize the fact that the condition is more apt to go on to rupture and to general peritonitis than in adults. This is accounted for by the relative inability of the peritoneum to withstand infection and to the small size of the omentum, which does not afford a good barrier to the spread of infection. In small children there are frequently only a few adhesions and scarcely any attempt at localization¹. The high incidence of peritonitis in appendicitis in children may to some extent be due to lack of recognition. So-called indigestion, colic, gastritis and so on may in reality be attacks of this disease which are not recognized until in an advanced state². Children, again, are usually purged more than adults before coming to the physician, and the unnecessary and dangerous use of castor oil and other cathartics may have much to do with furthering what might, otherwise, be a simple pathological process³. With the above points in mind delay in operation is unwise and may give time for the development of peritonitis⁴.

The case reported here is unusual in that the infection took the final form of a well walled-off abscess, which was not opened until eighteen days after the onset of illness. The amount of pus evacuated, eight ounces, is also unusual and constituted, in proportion to the size of the child, an abscess of enormous size.

The patient, a male infant eight months of age, had been well up to the onset of the present illness. March 3, 1929, he was taken ill with vomiting and fever. He had fever more or less constantly as high as 102° to 104°. He lost weight, became progressively paler, did not take feedings well, and appeared to have distress in the abdomen. He was seen by the reporter March 21. He was pale and thin, apparently having lost much weight. Physical examination showed normal findings except for the abdomen. This was considerably distended with gas and on the right side a mass, bulging out into the flank, was detectable, extending from the costal margin to the pelvis. It was smooth, tense, dull to percussion, and showed no fluctuation, its rounded margin could be palpated halfway to the umbilicus. The abdomen was tender in this area. By rectal examination the mass was felt extending into the pelvis and here also it was firm and non-fluctuant. The temperature was 103.6°, the weight about eighteen pounds.

A urinalysis showed normal findings and the absence of pus cells and red blood cells was especially noted. The white blood count was 30,000, the hæmoglobin 55 per cent, the red blood count 3,200,000.

Operation by Dr. C. F. Thomas. On opening the abdomen the mass came readily into view, felt firm, was not fluctuant and was attached by adhesions to neighboring coils of intestine. Upon opening into it a large amount of thin pus escaped. This it was impossible to measure but there were at least eight ounces of it. The appendix was not found nor was it searched for, as the child was not in good condition. The abdominal wall was closed with drainage. The organisms found were staphylococcus and hemolytic streptococcus.

After the operation the temperature remained elevated and the drainage from the

BRIEF COMMUNICATIONS

abscess was profuse. On the second day following, a blood transfusion was given into a neck vein. Soon after the temperature fell and varied from 99° to 101° for the next seven days. The baby took feedings well and, although the wound drained profusely, good progress was made. March 30 he experienced a severe gastro-intestinal upset with vomiting and diarrhoea which necessitated the use of parenteral fluid, and which gradually straightened out. He went home from the hospital April 4. The drainage continued in marked quantity, gradually ceasing, and the sinus became completely closed by May 27.

JOHN C S BATTLE, M B,
Port Huron, Mich

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AN INTESTINAL TROCAR--TRACTOR

I HAVE used with satisfaction for five years a new cork-screw type of intestinal trocar (photograph half size) which can be used as a tractor when the perforated coils are completely within the lumen of the gut, and for that reason prevents collapse, angulation and consequent contamination at point

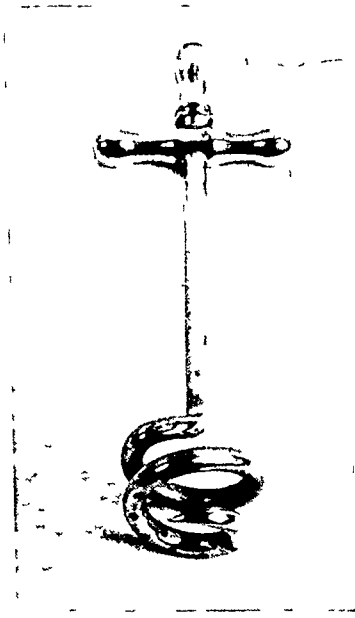


FIG 1

of puncture. After fixation of the distended intestine with Allis' clamps, a provisional purse string is applied at point of puncture. With continuous suction the trocar is screwed into the distended gut and ample time is taken for deflation. As a tractor the now hooded trocar can be pulled well outside the incision and any possible contamination can be safeguarded. Deflation and injection of saline solutions can be alternately applied by first shutting off manually the lumen of the intestine below and above the puncture. When the trocar is being withdrawn with continuous suction by being unscrewed, the purse string should be tied and subsequently reenforced with interrupted sutures, finally stitching lightly the omentum to this area. The menace of all methods of puncture of hyperdistended intestines is herniation of the rugous mucous mem-

brane through the separation of fibres of the muscular layers of the intestine, especially at the periphery, and this menace can be mitigated by round puncture more especially when applied to the lateral walls of the intestine where the layers of muscles are less attenuated. This trocar is not suitable for permanent drainage.

ROBERT M HARBIN, M D
Rome, Ga

BOOK REVIEWS

COLLECTED PAPERS OF THE MAYO CLINIC AND THE MAYO FOUNDATION
Edited by MRS M H MELLISH, RICHARD M HEWITT AND MILDRED A
FELKER Vol XX, 1928 Large octavo, cloth, pp 1197 Philadelphia, W S
Saunders Co, 1929

This is the twentieth year that an annual volume has been issued containing the papers produced during a given year by the members of the Staff of the Mayo Clinic and Foundation. A large number of these are reprinted in full from the various medical journals in which they were first published, some are abridged, and to some references only are given. In the present volume, 429 papers have come under consideration which represent the work of 214 authors. Of these, eighty-one papers are reprinted entire, forty-three are abridged and seventy-two are abstracted, of the remaining 233, references only are given. When one reflects that this is the output of one medical organization which is isolated so that it presents purely the opportunities and influence of a single scientific centre, one's appreciation of the magnitude and quality of the work is intensified.

When the two young Mayos in the late '80's after graduating in medicine, returned to their birthplace in an obscure town in Minnesota, they found as a field for them to work out their future the two agencies, St Mary's Hospital, operated by a Roman Catholic sisterhood, and the State Hospital for the Insane, maintained in the immediate neighborhood of the town. In these two institutions they began the work which by the development and growth of thirty-six years has reached the magnitude which the present volume reflects. The first evidence of this work which the ANNALS OF SURGERY received was in the shape of two brief reports made by them, each of one case, which were published in the July issue of 1893, volume xviii, pages 26 and 28. The amazing growth both in amount, research, teaching, advancement, and in suggestions of greater work yet to be done which has been the outcome of the wisdom, the skill, the administrative ability and the grand character of these two men, is well illustrated by this volume which is before us and back of which are the nineteen other volumes which have preceded it.

In the present volume ten papers are from the pen of William J Mayo and eleven papers from the pen of Charles Mayo. Of the other contributors, the names of Doctors Judd, Hunt, Rankin, Roundtree and Sheard appear the most frequently, each of these being credited with at least ten papers. The indices with which the volume is closed are worthy of mention. They contain an index of contributors, a bibliographic index, and an index of subjects, each of great value in facilitating the use of the book as a work of reference.

BOOK REVIEWS

PRINCIPLES AND PRACTICE OF MINOR SURGERY, by EDWARD MILTON FOOTE, M D , and EDWARD MEAKIN LIVINGSTON, M D Sixth edition, cloth, large octavo, pp 755 New York, D Appleton and Co, 1929

The progress of modern surgery is well illustrated by the size and quality of this book. It is twenty-two years since the first edition appeared in 1907. During this period, the demand for it has occasioned repeated editions until now the sixth edition appears in this large and elaborate volume, in the preparation of which the original author has summoned to his aid a younger teacher. The important surgical positions which the two authors have held and in which they still continue to work make their teaching quite authoritative and warrant the statement that such teaching represents the present accepted methods in the schools of the city of New York.

While it is true that the field of minor surgery is the only one into which the average practitioner should ever enter, and is also the one in which most surgeons find the majority of their patients, it is also too often true, especially in these latter days, that the average practitioner is often willing to venture into the fields of the most formidable major surgery, especially when dealing with conditions that involve the abdomen and the pelvis. There is some excuse for this, however, in the fact that the average practitioner nowadays is one who has enjoyed not only a prolonged professional training, but has also had his one or two years hospital training as an interne, so that he presents a degree of surgical skill and experience which need no longer confine him to minor surgery. On the other hand, the increasing frequency of accidents resulting from the industrial and automotive conditions of the present day have widely increased the demands in the field of minor surgery. The demands of asepsis likewise have not only increased vastly the extent of the surgical field, but have introduced into surgery new responsibilities of great importance. The authors of the present work have not contented themselves with the suturing of wounds, the opening of abscesses, the application of bandages and the treatment of superficial and minor external affections, but extend its field to include the spinal tap, the treatment of syphilis, tuberculosis and other infective diseases, many tumors and congenital defects.

The illustrations are numerous and excellent in their character. The descriptions of various conditions and procedures are brief, clear and practical. As will be seen, the book is far from being a pocket manual, which is as it should be, for no pocket manual could do adequate justice to the conditions which this book attempts to describe.

LEWIS S. PILCHER

EDITORIAL ADDRESS

The office of the Editor of the *Annals of Surgery* is located at 115 Cambridge Place, Brooklyn, New York. All contributions for publication, Books for Review, and Exchanges should be sent to this address.

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MEETING HELD IN CLEVELAND, O , MAY 2, 3, AND 4, 1929

ADDRESS OF THE PRESIDENT

A CONSIDERATION OF CERTAIN FEATURES OF PRESENT MEDICAL EDUCATION AND MEDICAL ETHICS

BY ELLSWORTH ELIOT, JR , M D
OF NEW YORK, N Y

ONE of the most urgent problems at this time, in need of prompt solution, is to determine in what way adequate medical care can be provided for those rural communities in which recent graduates in medicine are loath to take the places of those who have reached the end of their professional career. Economically, such an unfortunate condition forebodes disaster, for successful agriculture is a national necessity and proper medical care is as essential to the farmer and his family as are suitable educational opportunities for his children.

That the type of present medical education is at least in part accountable for the dwindling numbers of country practitioners is doubtless the case. A college degree followed by four years in a medical school and two years as a resident in a hospital requires an expenditure of from ten to fifteen thousand dollars. In seeking a proportionate return from the investment of that amount of capital a thickly populated district, in which hospital facilities may be found, is naturally chosen by the young graduate, and outlying sections are supplied by those who have failed to secure a foothold in a metropolitan centre. The considerable expenditure in time and money in acquiring a medical education is not the sole cause, however, of the dearth of the general practitioner. A scarcely less important factor is the development and popularity of the specialist. During the past generation this group, rapidly increasing in number, which necessarily crowds the cities, has been stimulated by the equally rapid advance in medical science, by the present methods of medical education, and to a considerable extent by the public demand. Instruction designed to prepare a student for the duties of a general practitioner has been submerged by undue attention and emphasis to the group of specialties in which the possibility of lucrative financial return and the opportunity to achieve professional success so strongly appeal to the undergraduate that the funda-

mental truths and true foundation of a medical education are frequently slighted. The fact that, in spite of the wide expanse of medical knowledge, the education of the general practitioner is still possible, cannot be too strongly emphasized.

The actual difficulty in making a living has made a country practice unattractive. Owing to the development of preventive medicine and district nursing, as well as to the improvement in hygiene and the organization of state laboratories, illness has become less frequent and the annual income of the physician is still further reduced by the fact that the automobile has made the specialist and hospital in the nearest city accessible to the well-to-do.

That this unfortunate state of affairs should be corrected, if possible, is self-evident. An increase alone of medical graduates would probably prove futile, for of those who fail to secure a livelihood in the city, only a part drift into the country, the remainder either seeking some form of institutional employment or withdrawing entirely from the practice of medicine to some more lucrative occupation. A radical modification of the preliminary course of study, as well as of the medical curriculum itself, has been suggested. That a preliminary college education is not indispensable has been proved by the distinguished career of more than one member of this association, while a considerable number of its senior members who completed their medical education in three years or less, have achieved noteworthy success and have made valuable contributions to surgical science. In those days the rapid expanse of surgery resulting from the discovery of Lister and the application of aseptic methods emphasized the shortcomings of their medical education and stimulated them to the acquisition of knowledge that only earnest and intensive study, continued over a long period of years, could supply. Whether the present graduate is similarly inspired is questionable. Perhaps the stimulation is less and the tendency to specialize concentrates their efforts to a single field, thereby dwarfing a broad foundation and possibly restricting any impulse to advance the science of medicine.

That the present medical curriculum could be extensively modified goes without saying. The early introduction of clinical instruction in both the hospital and dispensary could follow a relatively short period devoted to the study of elementary subjects, carried on chiefly in the high school, while laboratory courses could be largely curtailed. Graduates of such a course, supplemented by a modest experience as residents in a general hospital, would be qualified for routine general practice, especially with the cooperation and use of State laboratories and the advice of accessible consultants in difficult or intractable cases. That the intelligent high-school student is capable of acquiring a useful and practical knowledge of a clinical medical subject was demonstrated in an interesting way during the World War. One instance will suffice.

From the enlisted personnel of an evacuation hospital a restricted number of those who had had a partial or complete high-school training received theoretical instruction in the subject of anæsthesia and witnessed the administration of a general anæsthetic in

a limited number of cases. Subsequently in the Argonne campaign the members of this same group gave the anæsthetic to a large number of patients without an anæsthetic accident. While they enjoyed the advantage of anæsthetizing healthy young subjects, the fact that many operations were done in a condition of shock, or after extensive loss of blood, materially increased the anæsthetic risk. It is of interest to note that several of these anæsthetists studied medicine at the conclusion of the war and are now successful practitioners.

The desirability of such a modification of the medical curriculum as suggested is certainly questionable. Even if distinguished by the award of a lesser degree from graduates of standard schools (and in no wise is the suspension of the standard schools advocated) it is extremely doubtful that graduates of the shorter or clinical course would be content with the lot of a rural practitioner, and it is probable that they would compete actively and not unsuccessfully with physicians in metropolitan centres, the specialist included.

As a possible solution of this interesting problem the organization of small, modest county hospitals is earnestly suggested. Several such units have already been successfully established by private foundation in scattered communities. They have quickly enlisted local enthusiastic support, have grown in size and influence, and have proved of the greatest benefit to the health and welfare of the section they serve. Hospitals equipped at the start with the fundamental requirements for the care of the acutely ill afford a nucleus for medical research and attract ambitious and skilful recent graduates. In the State of New York it is said that communities in which a hospital has been established show no diminution in the number of physicians and in some instances an actual increase is noted. If the organization of such a hospital proves too great a burden for the community to shoulder, it should be established by an endowment of sufficient size to include a fixed salary for its chief medical officer. Such endowments ought not to be difficult to secure from those who recently have contributed in such lavish fashion to the endowment of universities and charitable institutions. Independent of political control hospitals of this character would quickly become active medical centres of the respective counties or districts in which graduate instruction by invited guests could be given not only in such subjects as preventive medicine, hygiene, serum therapy, etc., but in the equally important clinical subjects of medicine and surgery as well. It will be interesting in this connection to learn in what way the endowment fund at present being raised by the Albany Medical School will be applied to improve the medical standard of the rural practitioner. It is to be hoped that some plan will be devised that will provide practical medical instruction without material interruption of the physician's daily routine, since instruction of this type would prove much more valuable than the instruction given in the post-graduate schools of large cities, which is often inadequate in character and scope.

It is not intended in suggesting a possible modification of the present curriculum of the best medical schools of this country to lower their standards. The progress and development of the science of medicine can only be maintained by institutions of the highest class. It is simply a misfortune, if

not an actual sacrifice exacted of physicians at the present time, that the opportunity to earn a competence should be so long deferred. Not only must the high standard be maintained but constant effort must be made to detect and correct possible defects.

A still greater sacrifice is made by those who supplement their medical education by a service of several years' duration in hospitals of established reputation. Except for those of independent means the fourth decade is well advanced before those who follow this course can afford to establish a home and family. The opportunities both clinical and in the department of research, that such a course affords are unrivaled. Perhaps the best results are obtained when such a course is divided between several rather than taken in a single hospital. In the former event it is of advantage if, at least in one of the hospitals, the incumbent is brought more or less into contact with undergraduate medical instruction.

The reputation of a medical school is made by its graduates. Its aim should be not only to prepare students for the practice of medicine, but also to provide opportunity in its laboratories and clinics for the training of teachers, not so much to fill vacancies in its own faculty, for too much inbreeding is not a source of strength, as to supply efficient teachers for the staffs of sister institutions.

The reputation of a medical school as is the case with universities in general, is reflected in a measure by the geographical distribution of its students. Medical schools in which a majority of the States are represented on its roster enjoy a more envied reputation than those in which the larger number of its students come from adjacent communities.

In the conduct of the curriculum endeavor should be made to eliminate individual as well as departmental weaknesses. A member of the examining committee in a popular hospital of New York over a score of years ago, comparing the candidates for the position of resident from two rival medical schools stated that, while in the clinical examination of either a medical or surgical condition there was little difference in skill, there was the greatest difference in their knowledge of anatomy and pathology, in the former subject the students of one of the schools were proficient, and in the latter subject the students of the rival school excelled. It was evident that a weakness in the curriculum existed in either school, and yet in neither was any change made in the conduct of the department in question.

More recently, in the World War the lack of adequate training in anatomy was very apparent. The debridement of wounds without needless sacrifice of nervous and vascular structures, the identification of divided tendons and motor nerve trunks required an anatomical knowledge which was often deficient. In the field and evacuation hospitals the anatomical surgeon, so frequently the object of sneering criticism in civil practice, came into his own.

The lack of a proper foundation, moreover, is frequently shown in civil practice. In student instruction there has been a tendency to supersede former methods of examination and diagnosis by the application of the X-ray. In

dislocations, in obscure fractures in the vicinity of joints, in the diagnosis of thoracic and abdominal conditions, the interpretation of the radiogram is unduly emphasized in entire disregard of the fact that, later on in actual practice this most valuable method of diagnosis may not be available. It is a safe maxim to enforce that, in undergraduate instruction the result of X-ray examination should be utilized only after every effort has been made to establish the diagnosis without its assistance.

The advisability of compulsory attendance in student classes is very doubtful. Essential as it is in the preliminary school or college, such a policy seems unnecessary if not actually unwise, in professional schools in which students are investing their capital in preparation for a future livelihood. The extent of attendance, if voluntary, is in direct ratio to the value of the instruction given and is a reliable index of the teaching ability of the various members of the staff. Every professional school should aim to develop a student body, homogeneous, enthusiastic, eager to acquire knowledge and to teach each other, imbued with a spirit of friendly competition. There is no place for the drone, the lazy individual, or for those whose heart is not in their work. If students are carefully selected preliminary examinations will quickly winnow the wheat from the chaff and rigid final examination will determine the fitness of the candidate for the practice of his profession.

To detect and to correct the defects of a medical curriculum presents many difficulties. For this purpose, if properly utilized, the recent graduate is, it is believed, peculiarly qualified to give valuable assistance. Of late, a number of recent graduates of schools in Canada and of this country were requested to suggest modifications in undergraduate instruction in Anatomy and Surgery. Their replies were most interesting and while details need not be given, they suggested changes in the length and character of the instruction in anatomy, stressing the value of early demonstrations of the clinical features of simple uncomplicated fractures in connection with the study of osteology. They emphasized the value of animal surgery in the teaching of aseptic technic, suggesting that more time be devoted to this subject. Instruction in gross pathology and instruction in operative surgery on the cadaver were considered inadequate and attention was called to the almost complete lack of practical instruction in the administration of general anæsthetics. The contrast between the heads of two departments in which the instruction of one was compared to a bag of wind and of no value while the instruction of the other was said to have the merit of making the subject both interesting and comprehensive, was striking to say the least. In short, the comments were of such a nature as to warrant the conclusion that occasional conferences between suitable committees of the Faculty and recent graduates would prove of great value.

In the consideration of certain ethical standards so much attention has been given to the subject of commercialism in medicine that little need be added at this time. In the legal profession profit sharing is carried on with the full approval of lawyer and client. In medicine an analagous custom has

never been sanctioned. In many instances the compensation of the attending physician is doubtless disproportionate to that of the consultant to whose care the patient is consigned. A satisfactory adjustment has hitherto proved impossible. Secret division of the spoils cannot be too emphatically condemned. The undoubted increase of this pernicious custom demands some solution that can be reached only after a careful and exhaustive discussion in which both the layman and physician shall participate, and of which the result shall have the approval of the public at large.

One of the most invidious forms of this spirit of commercialism is the sordid avarice reflected in exorbitant charges for services rendered patients of modest means. The demand for the major portion of the annual wage or income of one of these victims transgresses every tradition of the medical profession. The spirit of kindness, of helpfulness, of sympathy, the satisfaction of restoring health and happiness without thought of compensation, in short, "All the gentler morals such as sway through life's more cultured walks and charm the way," are completely ignored. Unfortunately instances of this species of extortion are not rare and every effort should be made to eradicate this despicable evil.

Another species of fraud is practiced by the physician who, when a consultation is requested, introduces a colleague no more skilled than himself as the "specialist or professor", with whom the consultation fee is shared. These wolves in sheep's clothing do not hesitate to fatten on the scanty earnings of the honest laborer. Similarly guilty is the physician that, for a pittance, provides the plaintiff or his lawyer with a certificate alleging injuries that were never received. Such a certificate was recently presented to the adjuster of a local railroad company several days after an accident in which not even the slightest scratch was visible. During the past year the names of a number of physicians guilty of a similar offense were published in the daily press in connection with an investigation of the ambulance-chasing evil.

Equally lacking in honesty is the X-ray expert who testifies under oath to a false interpretation of radiograms for the benefit of the plaintiff in accident litigation. Perhaps the most striking instance of stultification on the part of an expert witness occurred recently, in which an increase in intracranial pressure from the effects of a head injury was claimed by the plaintiff. The request of the defendant for a spinal puncture was denied by the court after the presentation of an affidavit in which the plaintiff described the extreme torture to which he had been subjected by the spinal puncture as carried out by the testifying expert. He stated that during the operation his neck and spinal column were forcibly flexed on his thighs and abdomen while his neck was so tightly constricted by the hands of an assistant as to cause a sense of suffocation. These measures, it is well known, increase temporarily the normal intra-cranial pressure. The agony was such as to make him most unwilling to submit to a repetition of the operation.

It is not unnatural to assume that the physicians referred to in these various misdemeanors lacked both educational and moral training. It is unfor-

fortunate to be obliged to state, however, that in more than one instance the guilty party was a graduate in both arts and medicine of one of our oldest universities

In what way, if any, is either the subject of medical education or that of medical ethics the concern of members of this association? No body of men is better qualified to influence the development and conduct of our medical schools. Not only skilled in the practice of surgery but also in the art of teaching, the members of this association, in many instances represented on the faculties of long-established medical schools of the highest reputation, are peculiarly qualified in view of their experience to consider the wisdom of any change in either the character or length of a medical curriculum. By you the problem of how to provide rural communities with efficient medical attention must be solved—whether by the shortening of the period of preliminary education, or by some change in the medical curriculum, or perhaps by the organization and endowment of county or rural hospitals, if you believe the latter course desirable the application of the remedy will be undertaken by the lay public only after being assured of your approval and willing cooperation.

Of greater power, if possible, is your influence in medical ethics. Legislation or the action of official societies are of little avail without the earnest support and sympathy of the leaders of the medical profession. Their combined action is essential if satisfactory progress is to be made. No profession is without its black sheep. The ideal can never be attained, but the endeavor to approach it must never be relaxed. You are frequently consulted in regard to the choice of a profession. Your example and success constantly attract the ambitious to attempt to follow in your footsteps. It is only by continually striving to enlist students with the highest motives in the profession of medicine that its lofty humanitarian standards can be maintained and developed. To endeavor to place the science of surgery on a continually higher plane, no less than to contribute to its actual scientific advance must be the goal of every member of this association. May it carry the torch of progress ever forward in the future as in the past. Long live the American Surgical Association!

THE SMALL HOSPITAL-MEDICAL SCHOOL IN AMERICAN MEDICAL EDUCATION—IS THERE A PLACE FOR IT?

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IT is a reasonable presumption that the members of the American Surgical Association are deeply interested in the problems of medical education especially as they are related to the active practice of medicine. It seems, therefore, opportune that we contemplate for a few moments the trends of medical education in America and consider whether the results and the prospects are the best attainable from the standpoint of both the profession and the laity.

During the past two or three decades great changes have occurred in the principles and methods of the conduct of all industrial, commercial and financial enterprises. Larger and larger combinations have been effected with a conclusive demonstration of the greater productive and financial efficiency of those combinations than that of the smaller competing units. The result has been that the smaller unit is gradually disappearing and is being merged with the larger. Huge combinations of financial, mercantile and industrial enterprises are the fashion of our time, and still greater ones are in prospect. It is but natural that with the business world thus imbued with enthusiasm for such huge combinations, these successful men as trustees and governors of our educational institutions should feel that the same principles which have come to govern business in general should direct the trend of modern education, and inasmuch as these same successful men have furnished and are furnishing much of the money to maintain our educational institutions, it is but natural that they should have a very important voice and vote in determining many of the methods.

It has become a very popular theme to emphasize and advertise the large amounts of capital devoted to education, sometimes to the detriment of a careful consideration of the products of the so-called education. There is an increasing tendency today to rate educational institutions on the basis of their magnificent buildings and huge endowments rather than on the quality of the product they produce.

It is furthermore, a well-established fact that in all large aggregations of capital or education, the individual becomes submerged.

It is quite evident that in the minds of some at least of those responsible for our educational institutions, there has arisen the feeling that these institutions have grown too large and that mass production which has been such a great boon to industry can scarcely be considered a boon to education. An effort is now being made to discover some solution of this problem, and, in fact, some of our oldest and most famous institutions are embarking upon a plan to organize several smaller divisions or colleges within the larger one.

in order that the student may be considered more as an individual with an opportunity to remain such rather than become a standardized product

What is true of education in general is also true of medical education. From a period when there were too many medical schools of low attainment we have gradually passed to a period when we may possibly have too few and when most of those have grown too large. The tendency latterly has been to confine our medical schools chiefly to the largest centres of population and to emphasize the importance and necessity of large physical and financial structures. Many of our profession view with concern for both present and future the trend toward the development of huge institutions for the teaching and practice of medicine. Granted that this development has demonstrated its value in some ways, is there not a place for the smaller medical school which takes into consideration the needs of the community and of humanity?

Medical education has become a very expensive procedure when it costs an institution from two to three thousand dollars a year to educate a single student to which must be added the cost of the student's maintenance in our larger and more expensive cities. This fact alone makes it impossible for many promising young men to enter the profession, men of the type who, judged by the past, would be among the profession's best assets for the future.

Some of those in the forefront of the direction of medical education do not seem to fully realize that the first and chief duty of a medical school is to educate and prepare doctors to care for the sick and not to make as the chief object of medical education the production of so-called scientific investigators. The scientific investigator is and should be the by-product of medical education and not the goal. Best of all is that type of medical education which recognizes the important relationship of science as the foundation and background for medical practice.

It is unfortunate but in some instances true that the size of the budget of some medical schools bulks larger than the quality of the product or service to humanity.

In medical as perhaps in no other form of education, contacts are of the greatest importance—contacts with patient and teacher. We can all of us count on our fingers the few great teachers we have had and we all realize that we have been much more influenced by the personal contact at the bedside or in an operating or autopsy room than in the more formal setting of a class room. It is in the smaller medical schools that such intimacy of contact can be had to the best advantage. Many of our medical schools have started with or adopted the idea of small classes, but have found it very difficult to continue this policy because of the pressure of prospective students and the size of the plant and endowment. It is furthermore a fact that the burdens and responsibilities of the conduct of a clinical department of a large medical school are so great that little time is left for the head of the department to perfect himself in the art of clinical teaching.

The history of medical education amply justifies the contention that small medical schools of the highest type can be successfully maintained in the smaller cities where it is possible for the medical school to be an integral part of a university and of an adequate hospital, both of which are absolutely essential for the maintenance of a medical school of the proper standards. One need only cite the hospital-medical schools of Great Britain and of the Continent to amply illustrate and demonstrate this contention. Many such opportunities are presented in this country with one of which the writer has been associated for thirty years.

Fourteen years ago the Albany Medical School was reorganized and made an integral part of Union University. A definite plan was formulated, one of the chief factors of which was that it must be and remain a small school, the senior class of which should never number more than twenty-five or thirty students. From thirty-five to forty are admitted after careful inspection and selection and these are gradually reduced in the first two years to twenty-five or thirty. In this way intimacy of contact with teacher and patient is assured. In admitting students, preference is always given, other things being equal, to those from the surrounding territory. The large majority of the students thus come from a radius of 100 miles and many young men of small means are enabled to secure a medical education at a relatively small expense, many of whom are in part or whole self-supporting. Had it been necessary for these men to go to our larger institutions in the large cities, medical education would have been out of the question.

The principle was firmly established that the essential aim of the Albany Medical School was to serve the surrounding territory, first, in providing an opportunity for the right kind of man to secure an adequate medical education, and secondly, in endeavoring to influence him in later life to help in the service of that territory. When young men come from the country or a small town to a small medical school in a relatively small city, they are much more inclined to remain in that general vicinity than they are after four or more years in the white lights of a large city where the very air is polluted with commercialism. From such a small medical school comes a greater tendency to the practice of medicine and less of an one toward specialism, which is today one of the serious problems of medicine.

Gradually the physical equipment of the Albany Medical School and the Albany Hospital were merged until finally there resulted a medical school physically a part of the hospital with the establishment of the hospital on a full university basis of such a nature that every member of the teaching staff of the medical school occupies a corresponding position in the hospital. By providing hospital staff positions for the heads of the departments of anatomy, chemistry, physiology and pathology a twofold end was attained. The heads of these departments were forced more and more into clinical contacts and the students obtained a better appreciation of the relationship of the so-called scientific branches to the clinical and a better understanding of the practical utility of scientific measures as well as a realization

of the fact that science should in the last analysis serve man. The presence of the physiologist with the electrocardiograph at the bedside of a cardiac case is a much more impressive laboratory experiment than one conducted in the laboratory.

All the members of the clinical staff actively participate in the community life, making the hospital-medical school their chief responsibility. Thus was evolved what has been called the hospital-medical school on a university basis.

The problem of so-called rural medicine has long been recognized as an important one toward the solution of which the small medical school should especially devote its attention. To this end there has been evolved by the Albany Medical School a so-called five-point program as follows:

- 1 By giving preference in the selection of medical students to those whose affiliations are in its district.

- 2 By primarily training students for general practice and properly fitting them at moderate cost for such work.

- 3 By providing its graduates and other hospital internes with data concerning opportunities and locations where doctors are needed.

- 4 By cooperating with graduates and other physicians in the large district served by the school, giving them an opportunity to take graduate work, review and advanced courses, either formally or informally, as well as special work in all departments of the medical school.

- 5 By suitable publicity, informing rural communities of the advantage of employing their local doctor who can care adequately for more than 90 per cent of their ills, and whose cooperation and interest is of the greatest importance in the care of the remaining 10 per cent.

One of the most important features of this program is the maintenance of a liaison department between the hospital-medical school, other hospitals, the profession, public-health workers, and those responsible for the sick poor of the surrounding territory. Such a department functions all the while and in an impartial and humanitarian manner, thus avoiding the temptation and criticism of commercialism. In this way it is possible to establish and maintain a relationship between the man in rural practice and an institution rather than with an individual, and an institution which functions at all times for the benefit of both patient and doctor.

Great benefits accrue to a hospital from such an association with a medical school, for it becomes possible to render service of a character that could only be had in the most heavily endowed institutions and even then it would be less efficient because of the absence of the teaching spirit. From an economic standpoint, there can be no question but that the hospital-medical school is far more efficient than any combination or relationship so far devised. By thus improving the quality and scope of the service and reducing the cost, the hospital-medical school renders the greatest possible service to the community and helps in every way to maintain the highest standards of professional excellence. The intimate personal contact of the members of the staff both pre-clinical and clinical, reduces friction between individuals and

between departments and develops a spirit of cooperation which is of great benefit to teacher, student and patient.

As to the practical results obtained in carrying on a small medical school a brief review of the past fourteen years since the reorganization may not be out of place. Due to the splendid management of the dean, Dr. Thomas Ordway, and the unselfish cooperation of the faculty, the budget for the entire conduct of the school in the first five years was between \$35,000 and \$40,000 a year, and since then as more funds became available, it has been gradually increased to \$90,000 a year. This has made the cost per student about \$800 per year as compared with two to three thousand per year in many of the larger schools. The tuition of \$300 per year has been kept low in order to place the school within the means of promising young men of limited resources. At the present time there are 122 students in the school enrolled as follows: First year, 41, second year, 35, third year, 22, fourth year, 24.

During the fourteen years 324 men have been graduated and of those educated since the reorganization only one has failed in any final state or national board examination, and in that instance in only one subject. Of the 277 graduating during the first twelve years since the reorganization, 1915-1926, 153 or 56 per cent have settled in what is regarded as the area which the medical school serves, which is approximately 150 by 90 miles in extent. Those graduating in the past two years are as yet not definitely enough located to be statistically included.

As the aims of the medical school have become better understood and as greater influence has been exerted on the students and graduates, the percentage of the last three classes locating in this immediate territory has risen to 72 per cent.

For the past nine years, in cooperation with the New York State Department of Health, a course in Infectious Diseases and Public Health has been given each year. To this course have been added numerous clinical subjects treated from the more recent points of view and emphasizing advances in various phases of medicine. This course has been taken by about 250 health officers and other physicians.

A careful census of the physicians in the territory served by the Albany Medical School and embracing a population of well over a million shows that more than 50 per cent of the physicians practicing in that area are graduates of the Albany Medical School, thus demonstrating the validity of the theory that men who come to the school from that general territory are more apt to locate within the territory and thus provide a substantial basis for some solution of the problem of rural medicine as well as the importance of training men to be practicing physicians rather than scientists or specialists.

The Albany Medical School was among the first to adopt the plan of a reserve training course as outlined by the surgeon general and one of the first to graduate young men into that corps.

From this brief survey of the trend and cost of medical education and fourteen years' experience in the conduct of a small and inexpensive medical

school, it would appear that there is not only a place but a decided need for the small hospital-medical school, which can be maintained on the highest plane with the outlay of a comparatively small amount of money. It would further appear that such a hospital-medical school can be of the greatest assistance in the solution of the problem of rural medicine as well as the maintenance of the highest standards of medicine and service to the community.

Part of the duty and responsibility of the American Surgical Association is to train and inspire the next generation of doctors as our generation has been influenced and inspired by the outstanding figures of the past. Failure to do this may have resulted in developments of which we do not fully approve, but for which we are indirectly responsible because of our failure to actively participate.

DISCUSSION DR JOHN A. HARTWELL, of New York City, remarked that he had had an opportunity recently to sit on a committee in connection with the New York Academy of Medicine, which studied the question of the medical profession's attitude toward the community, a point that Doctor Eliot had brought out very forcibly, and one which Doctor Elting touched upon when he said those who were in the community of which I happen to be a member suffered from the commercial pollution of the atmosphere. That is a gentle impeachment that, to a very great extent, has to be recognized.

Feeling that the profession suffers from that, it has been faced with the problem of answering some of the questions which these two Fellows of the Association have put before it.

The study given this subject in this committee makes it clear that the only way this unfortunate commercial trend can be controlled is by the influence of the leaders in the profession. No code of ethics, no legislation, nothing except personal influence is going to have the desired effect. It is demonstrated that that personal influence must begin, as both the speakers have emphasized, in undergraduate training.

Much time is spent in providing these young men with a thorough training in scientific and clinical subjects, but very little in teaching them how to become practitioners of medicine in accordance with the highest traditions of the profession. They are left to acquire this by themselves without being given the benefit of the experience gained by the men in actual practice. That is not quite fair, because the moment they are thrown out on their own resources they come under influences that are exceedingly difficult to cope with.

There have been some very pathetic instances, in which it has been quite definitely demonstrated that an honest man, doing his best to make his way, has had to succumb to the situation that Doctor Eliot spoke of in the division of fees in one form or another, otherwise he could not compete with those in the community who are doing it.

DR JOHN M. T. FINNLY, of Baltimore, Md., said that Doctors Eliot and Elting had dealt with a situation which everyone who is in active practice

DISCUSSION

appreciates as really serious. The work that was headed by Mr Flexner some years ago succeeded in closing up a good many medical schools. That was unquestionably good work which, however, did not prove an unmixed blessing.

If the profession does not accept its responsibility to take care of the sick of the country at large, it simply lets down the bars and opens wide the gates for the army of quacks of one sort or another.

One reason why there are so many of them is simply the lack of qualified practitioners in many parts of the country, and especially in the smaller towns. He felt that Doctor Elting in his paper had really offered a practical solution.

He was heartily in accord with the bulk of the President's address, but disagreed very sharply on one point, speaking from the standpoint of his own experience. He said that perhaps he understood him incorrectly to advocate the establishment of small hospitals in rural communities. His experience with such institutions, from a surgical standpoint, is that they are an abomination. They may be all right from a medical standpoint. But from the surgical standpoint it means just this: in the minds of the uninitiated, in the holy of holies of the modern operating room any surgical sin may be committed because in such surroundings, one can do no surgical wrong. He has seen much really bad surgery and many poor results coming out of the small local hospitals performed by inexperienced operators with no adequate training and no surgical background.

DR JOHN H GIBBON, of Philadelphia suggested in the theme discussed by Doctor Elting that this question can be met to some extent by the large medical schools, which are not doing their duty to the public if one takes into consideration their plants and their endowments. The classes have been reduced, the plants have been increased, the endowments have been increased and the product has been reduced.

He said "A distinguished Frenchman came over here some years ago in order to investigate American medical education. I knew there would be little opportunity of getting a public expression of his real opinion but I had an opportunity to become somewhat intimate with him. In a quiet talk I asked him what impression he had. I will not mention the name of the institution of which he spoke, but it was a highly endowed institution with a very complete hospital, laboratories, etc. He said, 'I will tell you one thing—I saw very few students. I asked them how many there were, and they told me there were about 300.' I inquired what he thought of that. 'I'll tell you if we had the same plant and the same endowment in Paris, we would teach 5000.'"

DR ARTHUR D BEVAN, of Chicago, Ill. said "I would like to sound an optimistic note, a very optimistic note. We are doing so much better in medical education and in the practice of medicine in this country than we have ever done before that there is very little ground for pessimism.

"Great improvements were made by the medical profession itself long before we called on Mr Flexner, and Mr Pritchett of the Carnegie Foundation to help us in this work. Even before the Flexner report the American

THE SMALL HOSPITAL-MEDICAL SCHOOL

medical profession had reduced the number of medical schools in the country over 25 per cent , and within a few years it was reduced another 25 per cent The medical school situation has been tremendously improved

“We are developing good hospitals everywhere in this country We have more than 6000 hospitals I am surprised at the splendid work that is being done in the small hospital everywhere in the United States Go to California, or Texas, or Minnesota, or New England, and inspect these hospitals You will find the very best work being done everywhere, work that is needed The small hospitals of the country are caring for emergency cases that could not be sent to the great city hospitals Recognizing the improvements that are still ahead of us, we should feel most enthusiastic about the splendid progress that is being made and the splendid work that is being done ”

THE CAUSES OF FAILURE IN THE OPERATIVE TREATMENT OF CARCINOMA OF THE ŒSOPHAGUS

BY FRANZ TORLK, M D

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THIS paper will deal only with carcinoma of the thoracic and abdominal portions of the œsophagus not with carcinoma of the cervical portion, which has been repeatedly operated with success in accordance with fairly well-established modes of procedure and precautions against the incidence of mediastinitis, aspiration pneumonia, and secondary hæmorrhage

Statistical Data—Regarding the statistics on operation for carcinoma of the thoracic and abdominal portions of the œsophagus, it has been impossible for me to reach any conclusions on the percentage of successes and failures in the cases operated throughout the world, as the reports are too incomplete, and I am confining myself to data from the Lenox Hill Hospital of New York As yet, the failures far outnumber the successes In January, 1925, I published the data on the complete removal of the carcinomatous œsophagus from the thoracic cavity, the percentage of failures being 92.3 per cent It has improved slightly, the total percentage of failures having been reduced to 91.2 per cent Much of this unfavorable showing is due to our former eagerness to operate on every one of the rather limited number of patients at our disposal With our present judgment, the procedure in a number of those then operated should have gone no further than the exploratory thoracotomy But even with that allowance the percentage of operative recoveries would probably not have been a great deal higher, and so it behooves us to pass in review the main causes of failure and to offer suggestions for lessening the danger In rehearsing the causes of death, however, I have to return to the literature, as many of those reported have not occurred in my own personal experience From the published cases with disastrous outcome I have gleaned only a sufficient number to be representative of the difficulties encountered In connection with some of these I have stated what corollaries should, in my estimation, be drawn from the experience, in others the lesson to be learnt was too evident to require mention

Hæmorrhage—Of hæmorrhage, which has been responsible for a number of deaths, Eduard Rehn describes two cases In one, when performing the first stage of a two-stage extrapleural resection, he separated the tumor and wrapped it in iodoform gauze The patient died on the second day from severe secondary hæmorrhage The autopsy in that case also revealed metastasis in the regional and epigastric lymph nodes and in the liver, which had not been suspected owing to the moderate extent of the lesion The other case was one of death from hemothorax, in which atelectasis of the lung, due to compression, was found It seems evident that in both of these

cases the method of operation afforded too little space for safe hemostasis and, in the first case, also for the detection of metastases. The second case, in which the hemothorax caused atelectasis of the lung, might be cited as an argument in favor of drainage, but in my opinion it points more strongly to the desirability of an exposure sufficiently good to render accurate hemostasis possible, for prevention is better than cure.

Gauze tampon drainage, employed for hemostasis, has given rise to pneumothorax. To avoid this occurrence, Kuttner and Lotheissen have led the gauze out through an oblique canal, piercing each subsequent layer one to one and one-half centimetres further away. The obliquity of the channel is claimed to prevent pneumothorax.

A patient operated by Zaaijer died from hæmorrhage due to decubitus of the aorta. After decortication and collapse of the chest, according to his method, the upper stump of the oesophagus was displaced outwardly, crossing the aorta. The decubitus developed at the crossing point.

Dangerous and fatal hæmorrhage has occurred in the methods of removing the oesophagus without opening the thorax, *vis*, separating the upper portion of the oesophagus by an approach from the neck and the lower portion by an approach from the abdomen, after which it is either removed by invagination or is released from its central thoracic attachments by tunneling with the aid of a blunt instrument. The ligation of vessels torn in either of these procedures is of course impossible. Failure to control hæmorrhage is largely due to insufficient exposure owing to the choice of a method that fails to afford ample access.

The presence of blood in the pleura is objectionable even if the amount is far too small to figure as a dangerous hæmorrhage. Allen (*Sun, Gyn and Obstet*, July, 1927), in a series of experiments on animals, has shown that it predisposes very strongly to the development of empyema, and he attributes this to the fact that the blood furnishes an excellent culture medium for the growth of microorganisms.

Pneumothorax—Pneumothorax has caused death, especially in some cases of injury to the lung or bronchi, where there is a closed pneumothorax which steadily increases because of a valve action of the wound allowing air to enter but not to escape. Extrapleural attack, if performed without injury to the pleura, ought to safeguard against pneumothorax, nevertheless, cases of extrapleural resection have been reported in which death occurred on the day of the operation, ostensibly from pneumothorax. It must be assumed that the pleura was injured, an accident which not infrequently happens in extrapleural operations.

Pneumothorax has occurred even after completion of the operation and closure without drainage by the entrance of air between sutures at the chest or neck. Such occurrences emphasize the necessity of careful and accurate suturing. I have not seen a pneumothorax from this cause but have in one case experienced a leak occurring some days later owing to stitch infection.

If drainage is established, air may enter through the tube, however, the

occurrence of pneumothorax from that source may be avoided either by covering the drain extensively with rubber dam to prevent aspiration or by employing the method of tightly closed drainage, the end of the tube being immersed well beneath the level of a fluid in a bottle

Pleuritic exudate and infection of the Pleura—In transpleural operations the pleura is subjected to irritation by the necessary manipulations, resulting in an exudate of greater or less amount. Meyer reported a death on the second day from gradually increasing cyanosis, the autopsy showing compression of the lung by a serosanguineous exudate, in another fatal case the lung was compressed by fluid and air. On the other hand, the presence of an exudate may be of comparatively slight importance and be promptly absorbed, as I have had occasion to observe.

Of much more serious significance is the occurrence of infection of the pleura, especially that caused by rupture of the carcinoma which owing to its putrid character, soon leads to death. Even infection from injury to an uninvolved portion of the carcinomatous œsophagus is exceedingly virulent. In extrapleural operations this infection may be limited to the mediastinum, provided the pleura has escaped injury.

In the methods of removing the œsophagus without opening the thorax, either by invagination or by tunneling already referred to under "Hæmorrhage," the œsophagus is apt to tear during the procedure, and the tear is most likely to occur at the site of the carcinoma. The result would be a putrid infection of the pleura or mediastinum.

Leakage from suture of the œsophagus, one of the outstanding sources of infection, has happened in all cases of blind closure of the upper stump after resection although one of these Bircher's case, held for six days. To lessen the danger of leakage where the stump of the œsophagus is united with the stomach, Bircher, in 1918, inserted the œsophagus into the stomach in a manner similar to that of the rubber tube in a Witzel gastrostomy, a method which was subsequently copied and modified by Kirschner and others.

Leakage and death following anastomosis with a Murphy button and other buttons have been reported by Tiegel, Sauerbruch, and others.

Mediastinitis—The same causes that are active in bringing about infection of the pleura are also responsible for the occurrence of mediastinitis which may occur alone or in combination with infection of the pleura. As an example of the former I would cite a case published by Neuhoff in which death occurred one week after the first stage of a two-stage extrapleural operation. The most likely cause of infection in that case would be an injury to the œsophagus.

As an instance of the much more frequently occurring combined infection of mediastinum and pleura I would mention a case from our hospital in which the autopsy revealed a round cauterized area on the posterior surface of the left lung, which in all probability must have been due to imperfect protection at the time when the œsophagus stump was cauterized.

The result was an extensive mediastinal infection with purulent fluid in the posterior mediastinum and a thick greenish-yellow fibrinous exudate covering the bed of the removed œsophagus, the ascending aorta, the posterior surface of the pericardium and the root of the left lung

Necrosis of the Cut End of the Œsophagus—Where end-to-end union was performed following resection, necrosis at the cut end was often found, the result of this was leakage, infection of the pleura or mediastinum, and death. In these cases the necrosis was probably due to tension on the sutures. However, necrosis at the cut end has also been occasionally observed in cases where the œsophagus was drawn out through the neck and placed antethoracically beneath the skin, according to my method. Here, where the element of tension was excluded, the localized necrosis was probably in part due to the extensive liberation of the œsophagus, to the detriment of its nutrition, possibly there may have been some pressure on the œsophagus where it passed down between the clavicle and the skin.

To meet this tendency to necrosis of the end of the stump it is advisable, first, to separate the œsophagus from its attachments no higher up than absolutely necessary, secondly, to make sure that in the newly established antethoracic tunnel the œsophagus is nowhere subjected to pressure endangering its circulation, and thirdly to place the outlet of the subcutaneous tunnel sufficiently high to allow the œsophagus to protrude one or two centimetres, so that if necrosis should result, it may take place outside of the body. Lotheissen's suggested procedure of inserting a small drain alongside the œsophagus would, it is true, anticipate the treatment of a possible phlegmon but may, on the other hand, help to induce pressure necrosis and may pave the way for a pneumothorax or mediastinal emphysema. I should therefore prefer not to employ it as a precautionary measure.

Necrosis in the Course of the Uncut Œsophagus—Gangrene of the exposed part of the œsophagus causing mediastinitis and death has been reported by Lilienthal as occurring in two cases of two-stage extrapleural resection. A similar condition has been reported by Kuttner.

Pneumonia—Pneumonia as a cause of death has been reported a number of times. Of special interest in this connection is one of Sauerbruch's two cases of death from pneumonia, in which the autopsy showed that the œsophagus wound had completely healed.

Diaphragmatic Hernia—Diaphragmatic hernia as a cause of death has been mentioned in cases where, subsequent to operations on the œsophagus and cardia, a gap in the diaphragm was either imperfectly closed or allowed to remain entirely open.

Inanition—Inanition is a frequent cause of death in cases of carcinoma of the œsophagus where no operation is performed. Subsequent to resection of the carcinoma one would not expect inanition to appear as a cause of death. But it did happen in two of my own cases. The first of these was due to an unpardonable blunder. After the operation we found that only two or three ounces of food could be poured in through the stomach

tube, and even this amount did not remain inside. We were at that time very deeply interested in the study of the vagi and the effect of their division on the function of the stomach and tried in vain to explain this condition on the basis of some nerve influence, although it was not suggestive of the cardiospasm which might have been expected, till, at the end of the first week, it occurred to me to investigate whether possibly the tube was not in the stomach, and then only it turned out that an orderly, on getting the patient ready for operation, had accidentally pulled out the tube and, fearing a reprimand, had forcibly pushed it back into some pocket outside of the stomach newly made by his brutal and clumsy procedure. Its replacement now, however, did not save the patient, who died soon after, on the eighth day after operation, from inanition.

The second patient died a victim of his philosophy, for he refused to take food after the operation. On the third day, when I remonstrated with him on this matter, he declared that, although he appreciated what had been done for him, he had made up his mind that he did not wish to live because he had learnt that his case was one of cancer and that cancer always recurred. He continued to refuse nourishment and died on the seventh day from inanition.

Injury to the Vagus—The effect of injury to the vagus upon the heart has always been a matter of great interest, and the literature contains numerous observations varying from sudden death to complete absence of any effect on the heart or stomach. Thus, in most of the animal experiments, the bilateral division of the vagi above the diaphragm was well borne and did not cause subsequent cardiospasm. Of the cases that died directly from injury to the vagus I shall only mention two reported by Eduard Rehn. In one of these the division of the left vagus was made proximal to the place where the branches to the heart come off. In the other case the nerve had been cocaineized and had been separated from the oesophagus without any inadvertent occurrence, but when it was pushed aside a second time, for the purpose of wrapping the tumor in iodoform gauze, the patient died suddenly. An observation like that shows how dangerous to life irritation of the vagus, or tugging at it, may be.

Eppinger and Hess have made researches on the tone of the vagus. From their observations it appears probable that persons who have a heightened irritability of the autonomic nervous system and an exaggerated sensibility to pilocarpin (excessive salivation, profuse sweating, retardation of the pulse), are also particularly sensitive to injury of the vagus. Some patients manifested sudden heart block, while others were not thus affected, although the operation was performed with equal care and caution. On the basis of these studies Eduard Rehn suggested testing patients as to the tonicity of their vagi and to administer atropin before operation in case the test is positive. Grave, of Moscow, who recommends the same thing, states that irritation of the terminal sensory vagus filaments in the lung causes disturbance of respiration if there is an open pneumothorax and that it also

causes a "vagus pulse" The dogs manifested unsteadiness of the pulse wave in the pulmonary artery, after injection of atropin the pulse became steady again and somewhat more rapid Grave therefore recommends the subcutaneous injection of one-half to one milligram of atropin before endo-thoracic operations on the basis that it is of advantage not only in reducing the secretion of saliva but also by stimulating the respiratory centre This latter effect he considers important in case there is an excess of carbon dioxide, but herein he is probably mistaken, as carbon dioxide is itself a good stimulant of the respiratory function

As a means to reduce the irritability of the vagus by local measures, cocainization of the nerve suggested itself and has been employed Heller recommends regionary and perineural infiltration with novocain 5 per cent in the posterior mediastinum at the level of the hilus of the lung and arch of the aorta and claims that thereby both the centripetal conduction from the respiratory system and the centrifugal impulses can be completely blocked, so that stimuli, which otherwise would induce cardiac and respiratory paralysis, remain inactive The temporary paralysis of both vagi he claims to be harmless

Above the bifurcation of the trachea careless handling of the vagi is still more dangerous than lower down in its likelihood to cause cardiac collapse, as we may there be dealing with nerves leading directly to the heart In operating according to my method, in which the divided œsophagus is drawn through the neck, Lotheissen recommends starting at the neck under local anæsthesia, as does also Kuttner, claiming that, by doing so, a regional block of the vagi is brought about, he enhances this blocking by an infiltration of the mediastinum from the neck wound After the thorax is opened, the mediastinum is to be still further injected roundabout the vagi about the level of the bifurcation of the trachea, using 4 per cent novocain Then the separation of the nerve from the œsophagus is to be proceeded with and to be continued downward as far as the upper end of the tumor where, if the tumor is extirpable, the nerve is cut However, Rehn's case of death from irritation of the cocainized vagus, cited above, seems to give evidence that the method of suppressing reflex irritability by the use of a local anæsthetic does not absolve us from caution in handling the vagus To me, the best plan still appears to be, as I mentioned in an early publication, not to handle the nerve at all in liberating the œsophagus from it, but to keep close to the œsophagus until a place is reached where the nerve or a branch must be divided, and then to do it by a clean sharp cut

Shock—Deaths very soon after the operation have not been rare, and they have occurred after all the methods of procedure Most of these are ascribable to that condition of suddenly lowered vitality which we term shock, some may have been vagus deaths

Cardiac Insufficiency—Much more frequently the patient apparently recovers from the operation, and his appearance on the following day is quite encouraging, but at the end of the second day or on the third day

the pulse becomes markedly weak and the weakness progresses in spite of stimulation. Among my fatal cases cardiac insufficiency has played the leading rôle, other causes of death, such as infection and pneumothorax, having been the exception. The autopsy reports mention such findings as "heart enlarged, soft and flabby", "ventricular walls thinner than normal and all cavities dilated", "cardiac hypertrophy and dilatation", "chronic valvular endocarditis", "myocardial degeneration", "congestion and œdema of the lungs", doubtless also due to cardiac insufficiency.

The operation is often of such magnitude that the patient's vitality and particularly his heart, is unable to hold out. When a patient is run down by the disease, is toxæmic, and his heart has suffered in consequence, his chances to pull through are small. To my idea one of the most important problems is that of strengthening the heart sufficiently to undergo the task, and thus far that problem has not been solved. Cardiacs of course are indicated previous to operation as well as subsequently but in my experience they are of little avail in patients whose heart weakness is due to the toxic influence of a carcinoma. Lotheissen recommends the intravenous administration of ten cubic centimetres of a 50 per cent solution of dextrose on the evening before the operation or for several days preceding. That impresses me as being a more rational procedure than the attempt to digitalize.

Recurrence—Recurrence after operative recovery has either been metastatic or local. In some of the latter cases the excision is known to have been insufficient in extent, which brings home again the old lesson that the removal of an ample zone of apparently healthy tissue beyond the limits of the carcinoma is essential.

Operative Cures—Of patients operated abdominally alone there were five cures, operated by Bircher, Kummell, Kuttner, Volcker, Brun. Besides these, Bircher had a case that lived fourteen days and died of pneumonia, Volcker one that lived twenty-four days, Ach one that lived seventeen days. In the last named case, after abdominal resection of the tumor, the œsophagus was removed by invagination upward.

Of combined abdominothoracic cases, Zaaijer and Hedblom each had an operative success in a two-stage operation. Both of these died a few months after operation.

Of thoracic cases, Lilienthal had an operative success in an extrapleural resection and Eggers in two transpleural resections. Lilienthal's and one of Eggers' cases died from recurrence, the other case is comparatively recent. The longest follow-up case of excision of a carcinoma of the thoracic œsophagus was a case of mine that died thirteen years after operation, without recurrence, just before her eightieth birthday.

Animal Operations Compared With Those in Man—Why do operations on animals show so much better results than those on human beings? The

diversity is due to a number of factors (1) The dog's œsophagus is denser and finer (2) The resected portion has usually been very small, considerably smaller than would suffice even in a very early case of carcinoma (3) The resected part in the animal was not diseased but normal (4) The animal tissues being normal there was less likelihood of subsequent infection and a better chance for prompt union (5) The tissues being normal a minimum amount of time was consumed in liberating the parts to be resected, whereas in the human being the separation of the extensively attached carcinoma prolongs the operation (6) Finally, the animal experimenter never selects a dog that is suffering from a wasting disease or whose age is advanced but chooses a healthy subject

How Can the Results be Improved?—As the operations on animals were not performed with greater skill and superior surgical judgment than those on man it is certain that the general condition of the patient is a very important factor I have already mentioned that most of my fatal cases succumbed to cardiac insufficiency, demonstrated at autopsy if one was obtained, often apparent previous to operation, sometimes suspected but not established to a certainty If a method could be worked out by which the heart could be supported to stand the strain, it would help us very much Of course this problem is met most effectively by operating before the disease has had a chance to lower the patient's vitality to a material degree, in other words, by getting the case early But the difficulty lies in the fact that, as long as the mortality is so high, the early case will not be referred for operation, and as long as we operate only in late cases, our results will not show much improvement Then, what shall we do about it? I should advise refusing to operate upon patients whose vitality has declined to any material degree in consequence of their illness, or if their resistance is unsatisfactory for other reasons It is with a good deal of reluctance that I make this recommendation, for in cancer surgery it is my principle to extend to the utmost the indication for operating Here however, we are still facing the task of establishing a footing for this operation, so that it may obtain recognition by the medical public and eventually by the lay public

If the decision is in favor of operating, there should be no delay, as otherwise the cancer will extend locally, give rise to metastases, and develop toxæmia or increase its severity The metastases from which Zaaier's successful case died, are likely to have formed during the long time that elapsed before the tumor was removed,—three weeks between gastrostomy and the first stage of the two-stage operation and again three or four weeks before the final operation, the resection In one of my own cases, an extrapleural resection of the œsophagus through an approach similar to the one I employ for the transpleural operation, the autopsy revealed metastases that had not been found when gastrostomy was performed In that case two months had elapsed between gastrostomy and resection, due to the patient's own procrast-

DISCUSSION

tinuation I would therefore advise to operate as soon after the gastrostomy as the patient's condition will permit

The main operation should at first be considered to be an exploratory one. When the tumor is well exposed and it then appears doubtful whether a clean surgical excision with a wide margin of healthy tissue is feasible, no attempt should be made to go any further. Cases in which the tumor cannot be readily separated from the surrounding tissue are better not operated because the prolonged manipulation, the greater insult to highly irritable tissues, and the longer time needed for operating would augment the danger of shock. In an early case, where the tumor has no abnormal attachments, the time needed for dissecting out the œsophagus would not be excessive, approaching somewhat the ideal conditions found in the animal experiment. The œsophagus would also be of firmer consistency, its mucosa would show less congestion from irritation by the foul discharge, and, being more nearly normal, there would be less likelihood of an infection from that source, hemostasis would be easier in normal tissue than in infiltrated surroundings, the vagi would come off with less manipulation, and in every way the likelihood of shock and the strain on the heart would be diminished.

The picture of the present status of carcinoma of the œsophagus which I have presented is not a cheerful one, but nevertheless I am not despondent as to the future of this branch of surgery. The statistics of a 91 per cent mortality which I have given, do not really present a true picture of the condition, unless certain modifying conditions are taken into consideration. Thus, the two patients who passed out from inanition should not have died. There is no excuse for their death, and the blame should not be laid at the threshold of the operation. Had they recovered, the mortality would have dropped to about 85 per cent, and had we not been overenthusiastic in extending the indication for operating into fields that should have been avoided, the recoveries would have been somewhere between 15 and 20 per cent. If we could claim that figure or one somewhat better, we would be able to make a very strong plea for having the patients referred for surgical treatment in the early course of their affection, when their health and strength have not yet been undermined, and then the results would show quite a marked improvement.

DISCUSSION DR WILLY MEYER, of New York City, remarked that Doctor Torek had fully covered all the possibilities that have taken the majority of these patients away. The principal point to be emphasized is that as in so many other cases of carcinoma patients with cancer of the œsophagus reach the operating surgeon too late. Neither patient nor doctor can always be blamed for this occurrence. In many instances, patients do not come to the medical adviser except when their trouble is far advanced. Sometimes the doctor who first sees these patients with advancing difficulty in swallowing does not lay sufficient importance on the symptoms complained of. This con-

dition can only be improved upon by proper education of the public, and also by proper education of the medical profession. The educating of the public can be done by those medical organizations only that are able to reach the public in print in the daily press. The public must be taught that difficulty in swallowing may be just as serious as is acute abdominal pain in a case of acute appendicitis, that it may mean death if nothing is done. The public must be advised by the daily press that patients who have difficulty in swallowing which is not caused suddenly, after having swallowed a foreign body, should apply at a hospital without delay for careful investigation of the cause of the trouble, where the correct diagnosis can be made. The medical practitioner should not prescribe a tablet, or a pill, or a powder in such cases, but refer the patients to a hospital where a corps of trained men can, by proper teamwork, diagnose the case and thus likely catch the disease in its early stage.

For the radical operation of cancer of the oesophagus it was most unfortunate that it was born at about the same time when ray treatment was coming to the front. It was about twenty years ago when a number of aggressive surgeons who took interest in this subject were suffering from lack of material. The statement made in open meeting by that late, excellent colleague, Dr. Henry H. Janeway, who at that time was connected with the General Memorial Hospital in New York, was unforgettable. He then had 35 cases with malignant stricture of the oesophagus under his care that were treated by means of radium. When asked at a meeting of the New York Society for Thoracic Surgery what results he had seen, he said he had seen benefit in one case only and that had to remain doubtful because of microscopic examination of a piece of the tumor had not been made.

Since that time a number of cases of oesophageal stricture, due to the presence of a malignant growth, have been reported in the literature of the world as "cured by means of radium." Because surgeons were unable to report with certainty a series of happy results in this difficult chapter, and also on account of the naturally high operative mortality, it can be understood that the family physician as well as the patient were in favor of ray treatment. In order to get real light on this important subject, it seems to be a matter of necessity that those who are at present most influential in the medical profession should create an international commission, or call it an international committee, of three or five or six trusted men, consisting of an internist, surgeon, bronchoscopist, radiologist, pathologist and radium specialist for investigation of these reported cases of cure by means of radium, ascertaining that the patients really suffered from cancer of the oesophagus, and if so, whether they have been followed up. Such combined international work would be most important. It certainly cannot be denied that radium has cured malignancy of the skin and the mucosa with the deeper structures which in its pathological aspect was similar to that occurring in the oesophagus. But the real proof is missing so far.

DISCUSSION

It is unnecessary to speak of the various operative methods that come into consideration. The point to emphasize is that Doctor Torek's transpleural radical operation has blazed the trail. There are now three patients on record operated upon by this method. Doctor Torek's one and Doctor Eggers' two, who have recovered from this operation in the Lenox Hill Hospital of New York. Surely, if this operation were practised by many more surgeons who take interest in this class of cases, more operative recoveries would soon be reported. By giving the proper anæsthesia into the hands of an expert, pneumonia can be avoided in the majority of cases, and by adding a brief, air-tight drainage of the pleural cavity the danger of infectious pleurisy can frequently be overcome.

It should not be forgotten that at the present time *without the operation*, unless radium should be proved to be really curative sometimes 100 per cent of the patients suffering from œsophageal carcinoma die.

CONGENITAL HYPERTROPHIC PYLORIC STENOSIS AND ITS OPERATIVE TREATMENT

By ALFRED BROWN, M D
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A PARTIAL review of the voluminous literature on congenital hypertrophic pyloric stenosis establishes the fact that of late the majority of writers on the subject, whatever their specialties and personal leanings may be, believe that the condition, disease, or deformity call it what you will, should be classified among those amenable to surgical therapeutics. It is a mechanical condition and consequently best combated by mechanical attack. Though this is true it is well for the surgeon to bear in mind constantly that he is dealing with a perverted physiology of the gastrointestinal tract which requires a more intimate knowledge of the needs of the infant body than it is the good fortune of the average surgeon to possess, and restrict his part in the treatment of the patient to two main lines



FIG 1.—Section from pyloric stenosis in infant of four days
Note the normality of the muscle

of endeavor, leaving the remainder of the treatment in the hands of a competent pediatrician with whom he should cooperate.

As the result of the more or less complete block of the passage of food from stomach to duodenum, caused by the tumor at the pylorus, there is present a certain degree of dehydration and acidosis. The patient presents the problem of partial, at least, high intestinal obstruction and the decision as to whether this should be attacked at once by surgical operation, or an attempt made to better the condition of the infant by means directed to overcoming the dehydration, constitutes the first of the duties of the surgeon. The second has to do with the operative procedure itself and the subsequent care of the wound. Aside from post-operative surgical complications which may occur, the remainder of the treatment rests with the pediatrician and is not in the province of the surgeon.

In congenital hypertrophic pyloric stenosis the strongest argument in favor of surgical intervention even in mild cases is the permanence of the tumor when treated by other methods. That it is permanent is demonstrated in

three ways (1) Wollstein has shown that in cases which have died under medical treatment there is no change in the tumor and that gastro-enterostomy

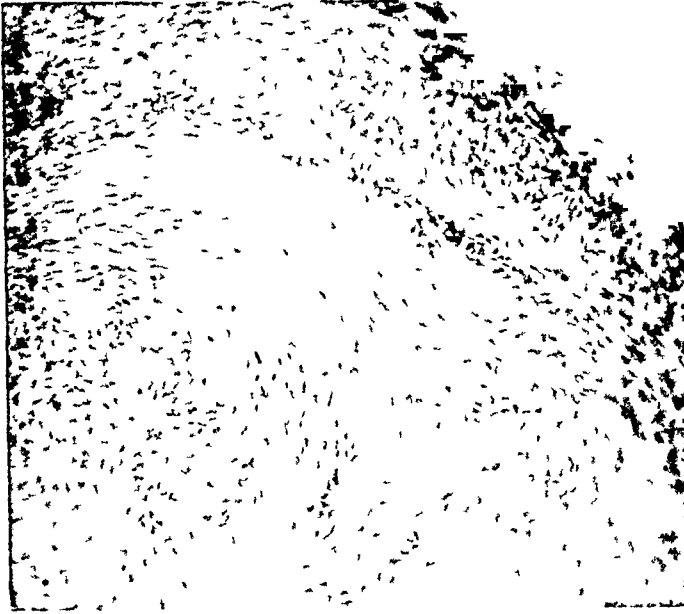


FIG 2—Section from pyloric stenosis in child of six and one half months. Note the great amount of fibrous tissue present in the tumor

though it relieves the symptoms and results in a clinical cure, has no effect on the tumor at the pylorus which remains unchanged (2) Oliver reports a case in an adult of fifty-one years of age in whom a typical tumor was found and the patient recovered after a Rammschmidt operation. Strachauer reports a similar case in a young man of twenty-one years of age with recovery after a similar operation. Cautley and Dent, Maylard, Landerer, and Russel have

also found tumors of the pylorus in adults which they believed to be congenital (3) Histologically the tumor may undergo more or less fibrous change and thus tend to increase the amount of constriction as shown in Case IX of my series—a child of six and a half months of age (See Fig 2)

With symptoms of vomiting of stomach contents without bile at first regurgitation with later development of projectile vomiting, the appearance of a peristaltic wave passing from left to right across the upper abdomen, beginning loss of weight, scanty urine; stools without curds, accompanied in some cases by a mass palpable below the liver usually well to the right of the median line, operation is indicated without further waiting. Fluoroscopy and X-ray



FIG 3—Method of holding infant. Arms are bandaged while buttocks are raised

Fluoroscopy and X-ray

CONGENITAL HYPERTROPHIC PYLORIC STENOSIS

pictures are advised by some writers but in my series were used only once and in that case (Case XII), a male of forty-two days, the examination had been made before the child came under the care of Doctors McClanahan and Henske, by whom it was referred to me

The earlier the operation is performed, the less shock results and the more rapid the convalescence. Feeding methods of treatment are not particularly successful and several cases have come to operation after futile attempts had been made, the only result being that the infant was in worse condition than



FIG 4—Method of holding infant. Bandaging of lower extremities completed

if operation had been performed when the diagnosis was first made

If the case is seen early and the child is in good condition it is operated upon at once. If the loss of weight is marked and dehydration is present, the

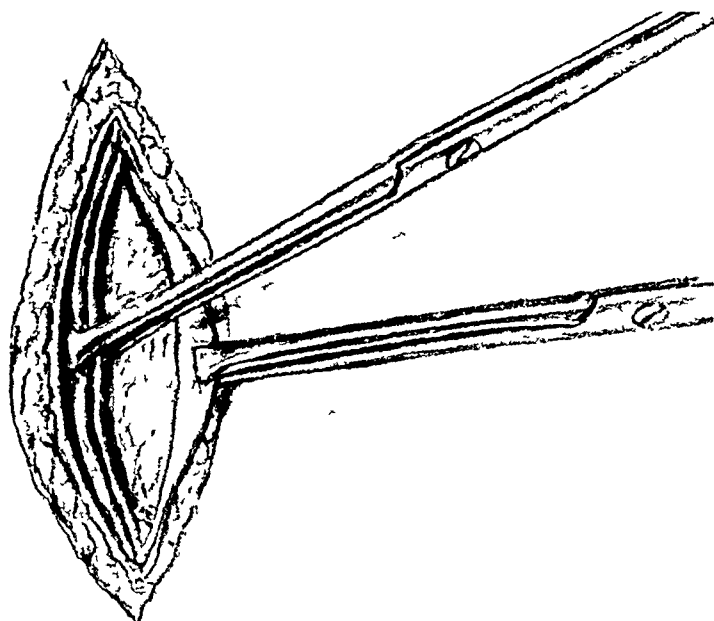


FIG 5—Abdominal incision made. Peritoneum and muscle grasped with Allis clamps

infant receives gastric lavage, proctoclysis of salt solution and glucose, and an intraperitoneal injection of salt solution. At the end of twelve or eighteen hours operation is performed as the maximum benefit is obtained by that time.

Like so many other forms of successful medical and surgical treatment the discovery of the present-day accepted form of operation for pyloric stenosis was made by chance. The major

operations of dilatation of the pylorus by Loreta's method, pyloroplasty and gastro-enterostomy were accompanied by so high a mortality that operative treatment did not appear justified. In 1906 Nicoll performed an operation consisting of a V-shaped submucous incision at right angles to the long axis of the pylorus and converting this into a Y-incision by suture, thus

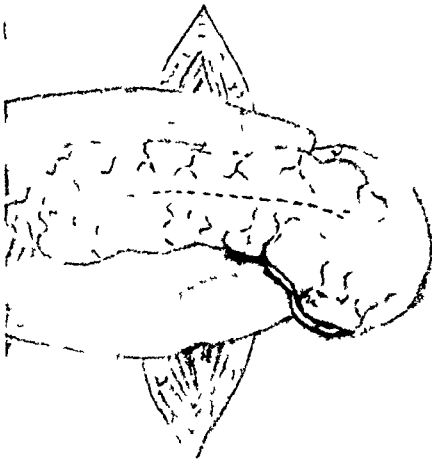


FIG. 6—Inc. of incision mapped out. Note that it stops short of the pyloro-duodenal junction.

The incision thus divides the sphincter for some millimetres in depth (more than five certainly) and the lips of the wound part voluntarily. A series of linen sutures are placed as in the procedure of Hemmcke-Mikulicz, transforming the longitudinal wound into a transverse wound, an autoplasty which manifestly enlarges the pylorus." In 1910 Weber described a similar procedure, and this description was seen by Rammstedt who attempted the operation but the stitches tore out and the split pylorus was returned to the abdomen after tacking a piece of omentum over the incision. The child recovered and in 1912 Rammstedt operated on a baby eighty-six days old, only splitting the pylorus. He describes his operation as follows "An incision five centimetres long opens the abdomen in the mid-line at the level of the pylorus

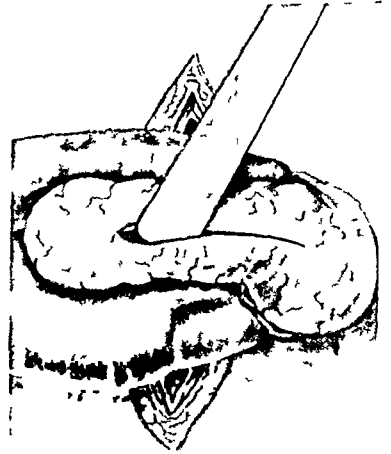


FIG. 7—Tumor incised. Muscle being split with handle of scalpel.

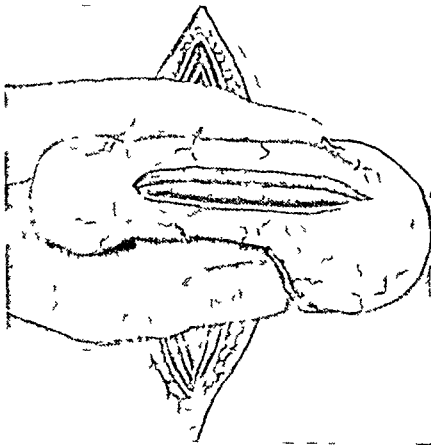


FIG. 8—Muscle split and mucosa bulges throughout entire length of tumor.

The stomach is enormously dilated. The pylorus is thicker than a thumb, cylindrical in shape, glistening reddish-white, hard as cartilage. Division of the thickened muscles on the anterior surface of the pylorus, only one circular suture at the point of change from pylorus to duodenum was necessary. The incision gaped widely and was left uncovered. Pylorus replaced, abdominal wall closed. Plaster bandage. Duration of the operation fifteen minutes. Ether narcosis."

The fundamental principle of the opera-

CONGENITAL HYPERTROPHIC PYLORIC STENOSIS

TABULATED SYNOPSIS

Twenty Cases of Pyloric Stenosis operated upon with no mortality

Case No	Name	Sex	Age at operation—days	Birth weight	Weight at operation	Per cent under weight	Onset average—days	Duration vomiting	Vomiting projectile	Wave	Tumor palpable	Pre operative preparation time	Date of operation	Operation time	Day of discharge	Weight at dismissal	Remarks
1	H H	M	38	12-0	9-13	+	28	10 days	+	+	0	3 days	7-3-23	8 min	15	10-0	
2	M J	F	52	5-0	6-0	36	35	17 days	+	+	0	0	11-14-23	8½ min	6	6-2½	
3	W A	M	28	10-0	7-15	0	21	7 days	+	+	+	0	1-16-24	8 min	5	8-2	
4	G R	M	40	6-12	5-8	50	10	30 days	+	+	0	29 days	10-6-24	4½ min	57	8-3¼	
5	G A	M	90	10-0	10-0	15	42	48 days	+	+	+	0	12-2-24	10 min	6	?	Lost three pounds in 4 weeks
6	D H	M	28	9-12	8-7	+	25	3 days	+	+	?	2 days	1-10-25	7 min	4	8-7½	Lost four ounces in 36 hours
7	W F	M	49	9-8	7-10	34	14	35 days	+	+	+	0	6-10-25	5 min	11	8-2¼	At four years 3'6", weight 40 lbs 1 oz Well March 21 1929 Weight 9½ at two weeks
8	N S	M	84		9-13	12	17	67 days	+28 days	+	0	0	11-21-25	7 n in	7	10-3	Has right inguinal hernia
9	C W	F	6½ mos	7-6	17-6¾	+	Birth	Life	+	+	0	?	12-15-25	15 min	6	?	
10	T H	M	49	8-3	9-10	-	42	7 days	+	+	0	0	4-11-26	7 min	7	10-4	Loss of eight ounces in week
11	J M	F	28	9-0	7-0	7	14	14 days	+	+	0	0	9-18-26	6 min	4	7-14	
12	R W	M	42	9-8	8-4½	11	28	14 days	+14 days	+	?	0	11-12-26	6 min	13	8-15½	X-ray shows retention
13	R T	M	42		8-1	13	35	7 days	+	+	?	0	12-1-26	10 min	6	8-2½	
14	C R	M	41	9-0	7-10	17	29	7 days	+3 days	+	+	Int 1½ 2 days	4-16-28	8 min	12	8-1½	One child had P S and died following operation
15	A K	M	53	6-4	8-4	20	Birth	Life	+	+	0	0	5-26-28	7 min	16	8-12	
16	P B	F	41	8-2	9-0	4	Birth	Life	+30 days	+	0		10-6-28	10 min	4	9-5	
17	E H	M	72	10-0	7-8½	37	21	51 days	+	+	+	12 hours	11-23-28	8 min	12	9-10	With intraperitoneal and proctoclysis gained three ounces in twelve hours pre-operative
18	R R	M	98	9-8	8-14	28	30	68 days	+14 days	+	+	4 days	12-23-28	8 min	13	10-1	
19	R J	M	28	11-0	8-15	+	14	14 days	+4 days	+	0	0	1-25-29	5½ min	12	9-1¼	
20	J G	F	4	7-8	7-0	0	0	4 days	+	+	0	0	3-19-29	9 min	3	7-0	

tion for pyloric stenosis—splitting the hypertrophied muscle down to the mucosa and closing the abdomen—was thus laid down by Rammstedt and

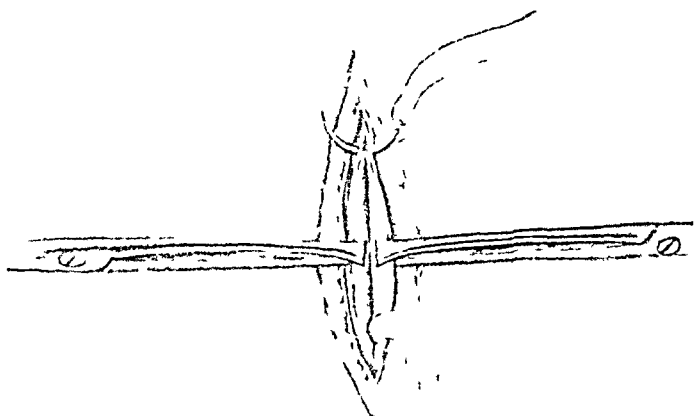


FIG 9—Catheter inserted. Peritoneum held in apposition with Allis clamps

remains the fundamental principle of the operation today. Modifications of the technic so far as the pylorus is concerned tend only to make the operation more complicated, less easily performed, more time consuming and hence more hazardous.

In a series of twenty cases with no fatalities* several points of technic have been developed which, though they are

not in any way modifications of the fundamentals of the operation, do appear to make it less dangerous and avoid certain difficulties which may arise. This operation is one of the very few in surgery in which I believe speed is of major importance. One is dealing with an infant, usually dehydrated and not in good condition and the less operative shock and the shorter the anæsthesia the better. I have not performed the operation under local anæsthesia but have employed ether in all cases. The infant is anæsthetized after everything is ready and the surgeon and assistant scrubbed up so that the incision is made immediately anæsthesia is induced and time so conserved. The infant is, as a rule, awake before it leaves the operating room.

Operative Technic—All instruments and sutures are prepared and ready upon the instrument table and are reduced in number to those actually needed, namely two small scalpels, two Allis clamps, one ring sponge forceps without serrations on the ring, two hemostats, one tissue forceps, one pair of scissors, two sutures of number zero chromic catgut threaded on full curved needles, one round and one cutting, and mounted in needle holders, and one rubber catheter, size 16 or 17 F, with a glass funnel inserted in its end.

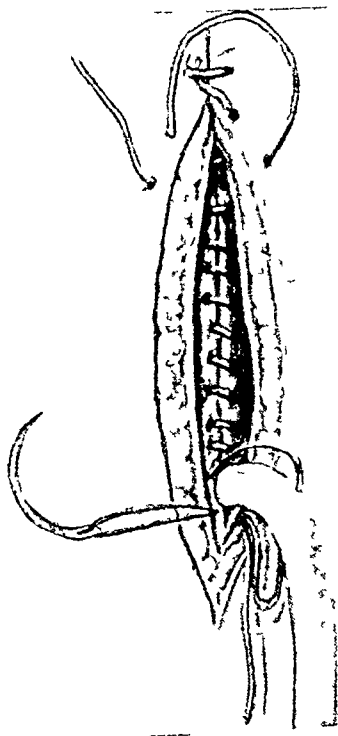


FIG 10—First row of sutures inserted. Second row started

* Since the above was written four cases have been operated upon successfully, making the series twenty-four cases with no fatalities to date.

CONGENITAL HYPERTROPHIC PYLORIC STENOSIS

As anaesthesia is induced after the field is prepared and draped, the method of holding the infant is important. For it I am indebted to Miss Agnes G Hain R N at that time anaesthetist to the Bishop Clarkson Memorial Hospital, Omaha. A narrow, padded board is used which has previously been warmed. On this the child is laid and while its buttocks are raised up, the arms from axillæ to wrists are bound to the board by a circular gauze bandage (Fig 3). The buttocks are then let down and the bandage continued from pelvis to ankles (Fig 4). In this way the infant can neither free nor harm itself and usually lies comparatively quiet during the induction of anaesthesia.

A right rectus incision from one to two inches long is made just above the level of the umbilicus. In the majority of cases, because of the dilatation of the stomach, the pylorus is pushed to the right and can be reached more easily through an incision in

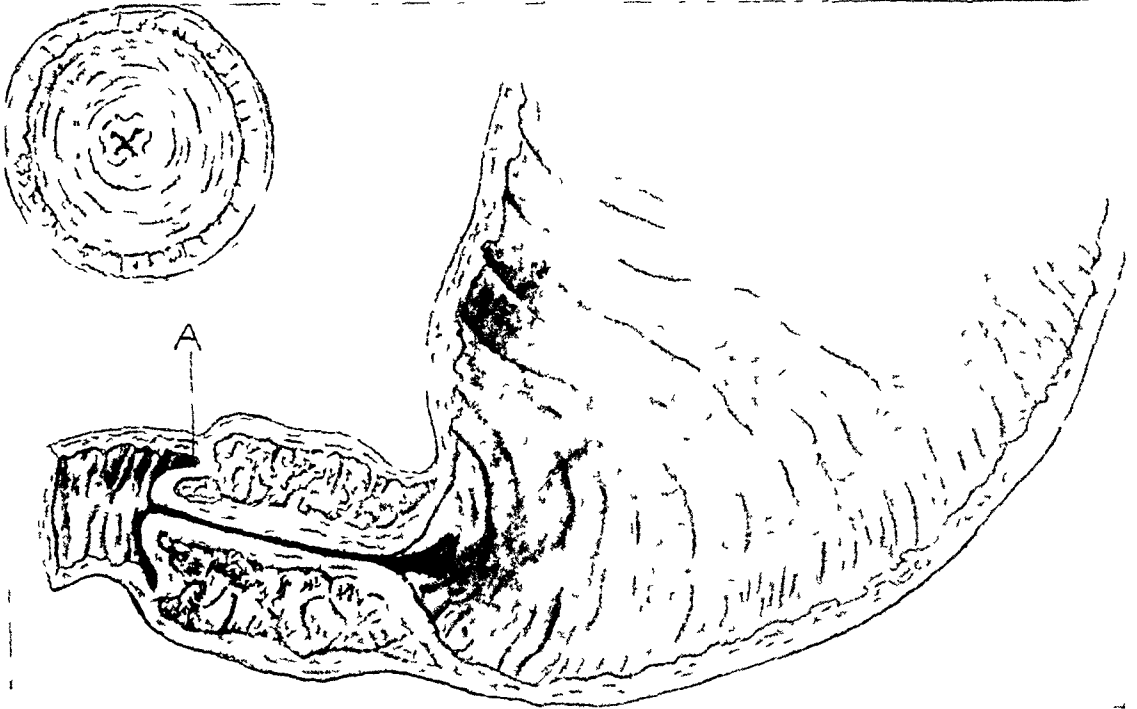


FIG 11—Longitudinal and cross section of congenital hypertrophic pylorus (after Richter). Note projection of the apex of the tumor into the duodenum. Incision at A will open the lumen of the gut.

this position than through one in the median line. As soon as the peritoneum is opened its edge, including a generous bite of the rectus muscle, is grasped on either side by an Allis clamp which is introduced from the side opposite the cut edge so that when it is turned over the peritoneum is everted (Fig 5), and by pulling the clamps directly away from the abdomen and at the same time pressing their gripping ends together the two portions of peritoneum are brought into apposition (Fig 9) and can be sutured without interference by the sticky cobweb-like omentum. No retractors are used and as a rule there is no bleeding.

The left index finger is introduced into the wound and the pyloric tumor sought for. As soon as it is felt a sponge forceps is passed along the finger, grasps the tumor and delivers it from the abdomen. It is then held between the index finger and thumb of the left hand which also serve to prevent the exit of abdominal contents. It has been my aim to allow the tumor, itself with only as much of stomach and duodenum as is necessary to permit delivery of the tumor from the abdomen, to be the only structures outside the abdominal incision, and in the great majority of cases this has been accomplished.

The tumor is then inspected for its most avascular area. Dyas has shown by injection of the vessels of the pyloric region in full-term babies that there is a rich plexus

of vessels upon the anterior surface of the pylorus with a comparative scarcity of vessels on the posterior surface. He therefore advises that the incision be made on the upper and posterior aspect of the pylorus. Thus, he states, can be accomplished by rotating the pylorus through an arc of ninety degrees and he has found that division of the pyloric attachments is not necessary to accomplish the splitting of the tumor in this area. I have made the incision through the whitest area above the terminal branches of the lower vessels on the anterior surface (Fig 6). The incision is carried longitudinally along the pyloric tumor for its full length beginning just on the stomach side



FIG 12—Low power photomicrograph showing full length of the tumor in congenital hypertrophic pyloric stenosis. Male baby six weeks old (Courtesy of Dr William Berry, Omaha, Neb.)

of the junction of the tumor with the duodenum to avoid any danger of encroaching on the duodenum itself. The incision passes through peritoneum and superficial muscle layer only.

The next step in the operation, splitting the tumor, is, I believe, the most important one. Here the two greatest dangers of the operation,

hemorrhage and opening the mucosa, may arise. All observers who have described the tumor of congenital pyloric stenosis agree in the description of its duodenal end. It is described as projecting into the duodenum like a cervix into the vagina (Fig 11). There is a reentrant angle around the periphery of the duodenal end of the tumor which is lined by the junction of the pyloric and duodenal mucosa. This represents the point where, in the normal organ, practically all of the circular muscle of the pylorus stops and the greater portion of the longitudinal fibres of the dilator of the pylorus dip down to become interlaced with the circular muscles as shown by Horton. It is also the point where the vessels are not constricted by the tumor. Reference to Figures 11 and 12 shows that the apparent duodenal end of the tumor as felt by the fingers is situated beyond the point where the tumor joins the muscular and peritoneal layers of the duodenum. Consequently, if the incision is made over this apparent end of the tumor as felt by the fingers the lumen of the gut may easily be opened at the angle, or one of the large vessels be divided at this point, and disagreeable, if not serious, hemorrhage result. However, in order to get the best result, it is necessary to divide the muscle fibres at the apex of the tumor as they represent the most marked point of constriction. This can be done safely by beginning the incision a short distance proximal to the duodeno-pyloric junction and dissecting bluntly with the handle of a scalpel working under the peritoneum toward the duodenal end of the tumor. When these fibres are divided the remainder of the tumor is split, still using the scalpel handle, until the mucosa bulges into the wound throughout its entire length (Fig 8).



FIG 13—Photomicrograph of distal end of the tumor of pyloric stenosis showing the projection of the muscle into the lumen of the duodenum and the relation of the large vessels to duodenal end of the tumor. Male baby six weeks old (Courtesy of Dr William Berry, Omaha, Nebr.)

The pylorus is now dropped back and the peritoneum and muscle sutured around a catheter inserted in the lower angle of the wound, the peritoneum being held together

CONGENITAL HYPERTROPHIC PYLORIC STENOSIS

as described previously (Fig 9) and the lowermost end of the suture inserted so that when pulled taut and tied the opening through which the catheter passes will be closed (Fig 10) Normal salt solution is now poured into the peritoneal cavity through the funnel until it flows out around the catheter This procedure was advocated by McClanahan and is designed to combat the dehydration The catheter is then withdrawn and the suture tied The final suture is then introduced, including skin and fascia of the rectus, and the wound dressed with vaseline and gauze held tightly in place with broad adhesive straps If nothing untoward happens the wound is not dressed until the seventh day, when it is cleaned and powdered and the chromic-gut sutures allowed to come out of themselves later

The time consumed in the operation detailed above has been as short as four and one-half minutes in a very desperate case and as long as fifteen minutes in a child six and one-half months old in whom an inspection of other organs was made The average time in the twenty cases was approximately seven and three-quarter minutes Hemostasis was not necessary in any case and in none was the mucosa opened

The major points in the twenty cases operated by the writer are noted upon an appended chart which is self-explanatory

Within the past month follow-up reports have been received from eleven cases In all, the child is reported as above the average height and weight for its present age with no symptoms referable to the gastro-intestinal tract Two other cases living in Omaha are known to be well and in good condition From the other seven no word has been received

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THERAPEUTIC ASPECTS OF GASTRO-INTESTINAL SUBCOMPETENCE

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AND

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THE divers functions of the units which constitute the digestive apparatus are so correlated and coordinated that unusual alterations in the activities of one unit are reflected in corresponding alterations in the functions of other units. This interdependence is manifest particularly promptly and regularly in gastro-intestinal motility, because propulsion of ingesta at rates appropriate to the functions of the various segments and timely expulsion from the distal segment are requisite to normal digestion.

Should peristaltic action exceed or fall below wholesome limits or the rhythm be upset, digestive disturbances occur. Conversely, unusual alterations in secretion or in absorption, in the character or in the transmission of nerve impulses, in the amount and in the potency of hormones and chalone and the presence of gross lesions, introduce abnormal variations in the tonicity and in the responsiveness of the musculature. In consequence the size and shape of segments of stomach and intestine and the nature of their peristalsis are modified.

Repeated fluoroscopic examinations of more or less robust or frail but ostensibly healthy individuals enabled Mills (Mills, R. Walter *Am Jour*

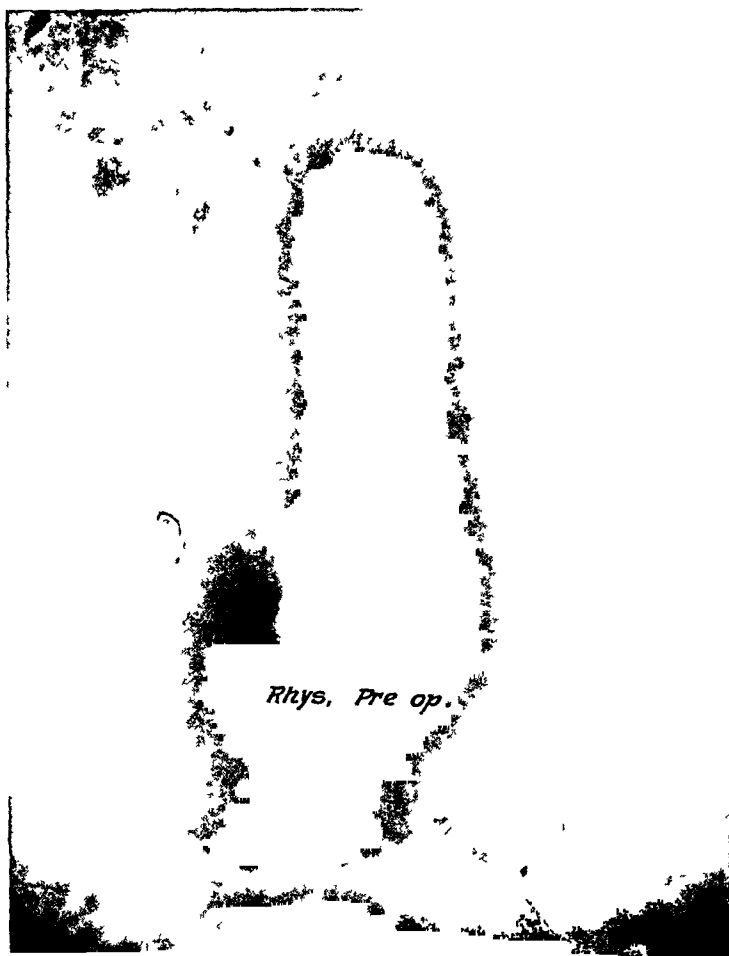


FIG 1—M. R. April 19, 1927. Soon after ingestion of barium.
Hypotonic stomach and duodenum.

Röntgenology, vol. 18, p. 731, 1922) to recognize wide variations in the normal size and shape of gastro-intestinal segments and in their propulsive power. Similar examinations of comparably robust and frail individuals who had been healthy previous to onset of diseases of their digestive apparatus, which were present in early as well as in late phases, have revealed equally wide variations in abnormal size, shape and propulsive power.

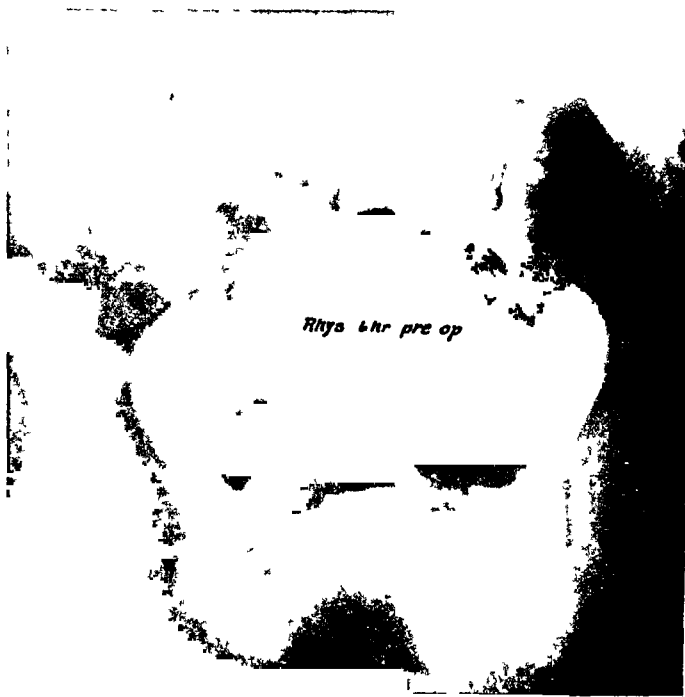


FIG. 2—M. R. April 9, 1927. Six hours after ingestion of barium. Slight duodenal retention. Main mass of barium in lower ileum. None in cecum.

Information thus provided has helped to make earlier and more accurate diagnoses possible, is disclosing the origin and evolution of many ailments and is indicating means to obtain further information. The value of this knowledge in designating prophylactic and therapeutic measures is obviously great. In addition similar examinations repeated during and after treatment show not only why some measures are the more effective in treating certain patients but also how mistakes can often be avoided.

The factor of paramount significance is propulsive power. In general, if it is maintained within wholesome limits, which fluctuate materially in different individuals and at intervals in the same individual, digestive disturbances do not occur and, if digestive disturbances are present, restitution of propulsive power is corrective. Hence the need to consider how propulsive power is maintained, how it is impaired, and by what means it may be rehabilitated.

The propulsive power of the gastro-intestinal tract provided by its neuromuscular equipment diminishes gradually but inconstantly and with periodic interruptions from cardia to anus. Progress of ingesta is commonly in inverse ratio to the normal calibre of the tube. Progress through the narrower portions results chiefly from local peristalsis, through the wider portions the pressure of ingesta propelled from proximal segments adds somewhat more to the propulsive power of local peristalsis. Transient obstructions occur normally at the outlets from stomach, ileum, and rectum. Propulsive power, because of its progressive diminution, has been likened to an inclined conduit wherein the diameter and declivity are variables and is called the gastro-intestinal gradient. Investigations of Alvarez have added

materially to knowledge of the production and control of gastro-intestinal propulsive power

The gastro-intestinal gradient is disturbed by active and passive obstructions. Active obstructions to progress of ingesta are presented by gross intrinsic and extrinsic lesions and by prolonged hypertonic contractions which constrict the lumen of segments of the tube more or less completely. Passive obstruction is caused by hypotonicity and atonicity or subcompetence of the gastro-intestinal muscularis consequent hypoperistalsis, subsequent dilatation, and stasis.

Whether the progress of ingesta be retarded by lesions that produce active or passive obstruction, the results are similar. Segments proximal to those obstructed are overdistended and forced to propel their contents against abnormally increased pressure. Demands for compensatory hyperperistalsis are made, first, upon the



FIG 3—M. R. April 22, 1927. Seventy two hours after ingestion of barium. Main mass of retained barium in cecum, ascending colon and proximal portion of transverse colon.

adjacent proximal segment, and, subsequently, upon those more remote, should the acute or chronic, active or passive, obstruction be unrelieved. There are significant dissimilarities between the forms of obstruction. More abrupt and more complete active obstructions tend to affect the entire digestive tract uniformly. Gradually increasing, less complete passive obstructions, although they also affect the entire tract, provoke more significant alterations in the less competent segments, that is, those having weakened neuromuscular apparatus.

Intrinsic causes of subcompetence are inherent or acquired frailties in the muscularis that predispose the cells to exhaustion and minute lesions that interfere with transmission of nerve impulses. Extrinsic causes are imbalance in central and visceral nervous systems, deficiencies in internal secretions (thyroid and adrenal) and in external secretions (liver and possibly pancreas), dehydration, anaemia, systemic fatigue and intoxication, unwholesome methods of living and obstruction in distal intestinal segments. The causes act singly or in combination and the segments more commonly affected are adjacent to structures which exert sphincteric and check-valve actions, namely, stomach and duodenum, terminal ileum and proximal colon, and rectum.

Should the inherent weakness in the muscularis be the chief provocative factor, subcompetence develops sooner or later (more commonly between twenty and fifty) in consequence of fatigue incidental to normal activities according as the frailties are greater or lesser. Single segments are usually affected, the proximal colon, rectum, stomach, and duodenum in order of frequency. More often intrinsic and extrinsic causes are combined. Primary

subcompetence of distal segments produces retrograde hyperperistalsis followed by hypoperistalsis and dilatation in proximal weaker segments. Thus occur single and diverse combinations of multiple disturbances in the gradient. Subcompetence occurs in various segments without gross gastric or duodenal lesions, or they may coexist. Then the subcompetence of segments may be in provocative or consequential relationship to gross lesions thus making diagnosis more difficult and complicating therapy.

The causes and consequences of subcompetence of gastro-intestinal segments and of the myocardium are strikingly similar. Fatigue and exhaustion produced by disturbances in the neuromuscular



FIG 4—M. R. April 26, 1927. Twenty four hours after barium enema. Main retention as after ingestion (Fig 3) in cecum, ascending colon and proximal portion of transverse colon.

apparatus, excess, deficits, or alterations in concentration of media to be propelled and in distal or peripheral resistance, and chronic intoxication are the usual provocations. The effects are failures to propel contents and the subsequent passive stagnation or congestion. Diagnoses of the two states are simple and disclose the provocative factors, among them some that can and should be eliminated. Prognoses may be difficult for it is sometimes impossible to estimate accurately the recoverability of hypotonic smooth or cardiac muscle should existent injurious influences be eliminated and adequate rest be provided. Prophylaxis is quite the same, to wit: The avoidance of local, mental, and systemic fatigue and of intoxication. So too, the chief thera-

peutic measures are alike, reduction in distal or peripheral resistance, provision of adequate media of suitable concentration and restriction of mental and physical exertion, all to provide rest and opportunity for recuperation. However, one striking dissimilarity occurs in treatment. The heart produces the propulsive power for the circulation of blood, so cardiac lesions are paramount. Although the stomach and duodenum produce the most effective propulsive power that maintains the gastro-intestinal gradient, distal intestinal segments also contribute thereto. If any segment becomes irreparably injured, it may be excluded or excised and the gradient reestablished.

CLINICAL ASPECTS

The causes and consequences of segmental subcompetence will be outlined. Operations are considered, as a rule, only when all appropriate non-operative measures have proved inefficacious after ample trial, and provided the mental and physical handicaps of patients do not suffice to make rehabilitation impossible. Occasionally patients who are self-supporting, sometimes the chief dependence of others, and cannot afford prolonged treatment for pronounced disturbances, which are

probably to some extent permanent, are given the more certain benefits to be derived from intervention without undue delay.

Non-operative measures, which include rest, diet, fresh air, sunshine, introduction of wholesome habits, etc., should be employed in preparation for operation as they lessen immediate dangers and expedite convalescence. They should be adopted as permanent modes of living following operations, to consolidate recovery and to obviate the development of other disturbances. These patients are seldom well-balanced mentally or physically so that however deftly a suitable operation is performed, it is only a part of treatment that should be continued throughout life.

The reason why operative treatment of patients so affected has been discountenanced is that subcompetence has been classified as a functional



FIG 5—M. R. December 3, 1928. Stomach and duodenum one and a half years after excision of terminal ileum, cæcum, ascending colon and proximal transverse colon. Hypotonicity less than before operation shown in Fig. 1.

disorder without anatomic lesions which is obviously absurd, and it has been expected that operation alone would restore perfect health to individuals who are not and never can be robust

The operative revision of subcompetent segments unassociated with gross gastric and duodenal lesions will be considered first, and then the surgical treatment of patients in whom subcompetence and gross lesions coexist

Subcompetence of Segments without Gross Gastroduodenal Lesions—

Single segments may be affected alone or all may be more or less subcompetent, and then the distal segments are first involved and have produced retrograde disturbances. Therefore, they will be discussed in reverse order



FIG. 6—M. R. December 3, 1928. No duodenal retention. Bulk of barium in proximal transverse colon six hours after ingestion. Barium whicars before operation (Fig. 3) none had reached the cæcum.

times in sigmoid, often in ascending colon, cæcum, occasionally in terminal ileum, rarely in duodenum and stomach

Treatment Elimination of lesions provoking sphincter spasm, perineorrhaphy, and correction of habits

Ascending Colon and Cæcum—Causes Inherent frailties in muscularis, nervous instability, stasis in rectum

Effects (a) Local—hypoperistalsis, dilatation, stagnation of contents even for seventy-two hours, absorption of noxious substances, superficial ulcers of mucosa, penetration of intact or ulcerated mucosa by bacteria, contamination of adjacent lymph glands (commonly by colon bacilli, tubercle bacilli, and sometimes streptococci), lymphadenitis and appendicitis (b) Systemic—toxæmia, lymphogenous and hematogenous dissemination of bacteria, anorexia, malnutrition, intensification of nerves instability, glandular, osseous and pulmonary tuberculosis (c) Retrograde—hyperperistalsis followed by hypoperistalsis, dilatation and stasis in terminal ileum, duodenum, and stomach, indigestion, nausea and periodic vomiting, especially after fatigue

Treatment Correction of rectal stasis, resection of terminal ileum, cæcum and first portion of transverse colon and implantation of the end of the ileum into the

GASTRO-INTESTINAL SUBCOMPETENCE

side of the colon. The limits of bowel needing resection are usually more accurately defined by the inflammation in the regional lymph glands than by radiosopic examinations or the appearance of the bowel itself. Subsequent correction of habits, suitable diets, and avoidance of overfatigue will prevent a recurrence of similar disturbances.

CASE I—B B, female, secretary, twenty-eight years of age. Inherently atonic, of little endurance, obviously liable to tuberculosis because of malnutrition, chronic indigestion and constipation. Hyposthenic type. Stomach and sigmoid slightly atonic. Subcompetence of cæcum and ascending colon pronounced. Retention over seventy-two hours. All aggravated by fatigue.

March 29, 1916—Resection of terminal ileum, cæcum, ascending and first half of transverse colon. Lymphadenitis advanced. Uninterrupted recovery.

October, 1916—Stomach empties in seven hours. Constipation relieved. Endurance increased. Is within ten pounds of peak weight.

May 27, 1929—Has worked constantly for thirteen years. Intervals of fatigue have produced digestive upsets and loss of weight, yet she has seldom been incapacitated even with colds. Stomach empties in six hours. No abnormality throughout intestinal tract. Endurance is as high as it ever has been though she is seventeen pounds under peak weight. A tendency to mild secondary anæmia has disappeared. Responses of lymph tissue and reticulo-endothelium, which formerly indicated scant resistance to tuberculosis, are now such as to suggest insusceptibility.

Comment—This woman has been enabled to work constantly and satisfactorily and perhaps has been protected against tuberculosis which has affected relatives. She is not and cannot be robust.

Terminal Ileum—Causes. Inherent and acquired frailties are uncommon. The usual provocation is stasis in the cæcum, occasionally it is appendicitis, rarely cholecystitis.

Effects. (a) Local—hypoperistalsis, stagnation of contents, absorption of noxious substances, penetration of mucosa and lymph follicles by bacteria, lymphadenitis. (b) Systemic—toxæmia, lymphogenous and hematogenous dissemination of bacteria, notably tubercle bacilli, and subsequent glandular, osseous and pulmonary tuberculosis develop in those who are susceptible. (c) Retrograde—hyperperistalsis subsequent hypoperistalsis and stagnation in duodenum and stomach, pain, nausea, vomiting and lesser grades of indigestion.

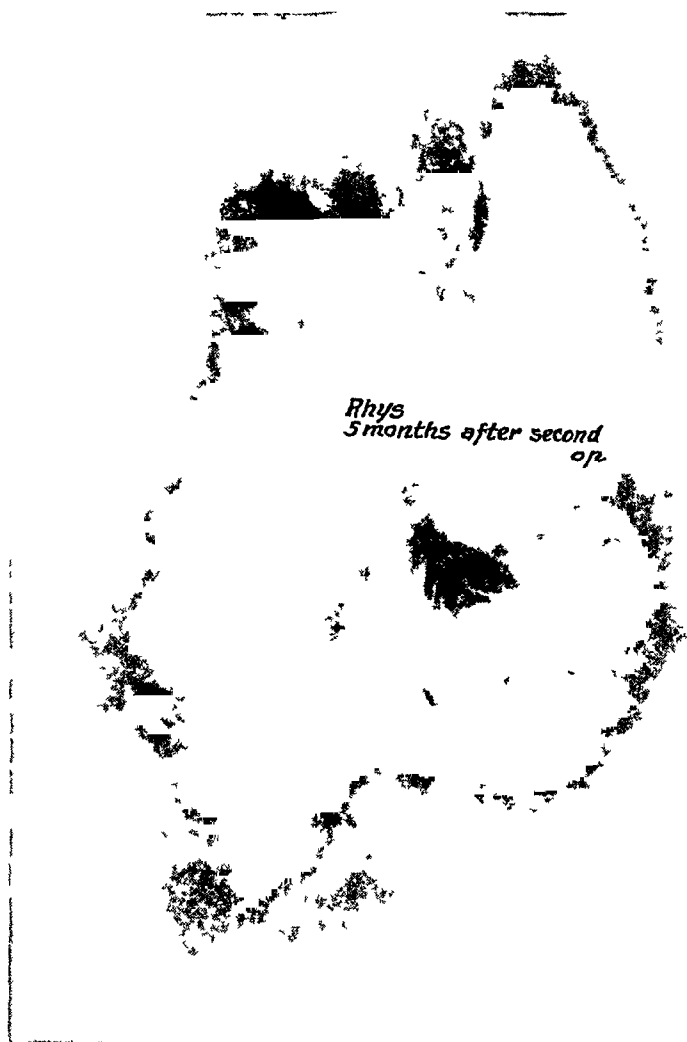


FIG 7—M R April 6, 1929. Stomach, duodenum, and jejunum immediately after ingestion of barium. Skiagram taken five months after duodenojejunosomy (end to side anastomosis) performed to relieve duodenal incompetence. Compare with Figs 1 and 5.

Treatment Appendectomy, cholecystectomy or resection as above described Appropriate after cure

CASE II—G F, school boy, eight years of age For the past two years he has suffered periodically from attacks of pain in lower right abdomen, loss of appetite, nausea, and vomiting, but not constipation Attacks have not been characteristic of appendicitis Two barium X-ray examinations, months apart, revealed stasis in terminal ileum but no other abnormality

January 12, 1929—Laprotomy No lesions discovered in biliary tract, stomach, duodenum, colon or even in terminal ileum A long, large, non-adherent appendix in which there was no gross evidence of present or past inflammation was removed Rapid recovery

May 29, 1929—Boy has had no more attacks and has gained in weight and strength Barium X-ray examination revealed normal propulsive power throughout gastro-intestinal tract

Comment—Irritation in appendix, too slight to provoke acute inflammation, caused reflex obstruction and subcompetence in the terminal ileum which disappeared after appendix was removed

Duodenum—Causes Inherent and acquired frailties in muscularis, stagnation in terminal ileum and proximal colon, loss of weight and of tone in abdominal muscles which permits the sagging of



FIG 8—M R April 6 1929 Six hours after ingestion of barium Main mass of barium in terminal ileum and proximal colon Compare with Figs 2 and 7

small intestine and cæcum that increases compression of transverse portion of duodenum by pressure of superior mesenteric artery, appendicitis, and cholecystitis

Effects (a) Local—hyperperistalsis and regurgitation of contents into stomach, hypoperistalsis, atonicity, and stagnation, penetration of mucosa by bacteria, lymphangitis and lymphadenitis, œdema of mucosa, obstruction to discharge of bile and pancreatic secretions (b) Systemic—malnutrition, restricted activity of pancreas and liver, toxæmia (c) Retrograde—hyperperistalsis, later hypoperistalsis, dilatation and stagnation in stomach, anorexia, pain and malnutrition, restriction of activity of pancreas and liver, chronic pancreatitis and cholecystitis

Treatment Appendectomy, cholecystectomy, relief of stasis in distal intestinal segments, duodenojejunostomy (antecolic or retrocolic), accomplished either by lateral anastomosis or preferably by transecting the duodenum near the termination of its descending portion, inverting the distal end and implanting the proximal end into the side of the jejunum

CASE III—E H, nurse, age thirty years of age Two years previously appendix was removed because of recurrent attacks of subacute inflammation Relieved of digestive distresses until two months ago when symptoms of cholecystitis developed Material loss in weight and increasing severity of attacks led to reexamination which revealed

incompetence of the duodenum and a kink in the ampulla of the gall-bladder that explained attacks

April 9, 1928—No active cholecystitis present but evidence of previous pericholecystitis that had involved stomach and duodenum Gall-bladder after removal showed not only kink affecting mucosa and submucosa but also stricture of cystic duct Uneventful recovery following transfusion for thrombocytopenic purpura

April 2, 1929—Has regained health Stomach and duodenum competent, emptying in three and a half hours

Comment—Combined influences of appendicitis in provoking cholecystitis and of cholecystitis in causing duodenal incompetence are notable More remarkable was the probable correction of reduction in platelets (82,000) by the liver injury from cholecystitis Recovery from duodenal incompetence and disappearance of tendency to abnormal bleeding confirm these hypotheses

CASE IV—M R, secretary, thirty-three years of age Never robust, but well and active until the age of twenty-six, when she had typhoid fever Later she was thrown upon her own resources and in consequence overworked Attacks of pain in lower right quadrant, nausea, vomiting, capricious appetite, malnutrition, constipation, loss of weight and endurance led to general atonicity and nervous imbalance Incompetence of duodenum, cæcum, and ascending colon revealed by physical and X-ray examinations

June 6, 1927—Duodenum was dilated and atonic up to the superior mesenteric artery, stomach less dilated and atonic Jejunum and ileum appeared normal Cæcum and ascending colon boggy, dilated, and atonic Many enlarged lymph glands, some as large as almonds, present in and behind the mesocolon from ileum to middle of transverse colon Simple cyst of right ovary

Terminal six inches of ileum, cæcum, ascending and proximal half of transverse colon removed End-to-side anastomosis between distal ileum and proximal colon Removal of right ovary Recovery uneventful

December 16, 1928—Improved for six months after resection of cæcum and ascending colon Then tonsillectomy for recurrent inflammation Thereafter she began to have discomfort in right upper quadrant of abdomen, lost appetite, weight, and strength Incompetence of stomach and duodenum revealed by physical and X-ray examinations

At operation duodenum was more dilated and flabby than before and had elongated Stomach not greatly different Duodenum was transected proximal to superior mesenteric artery, distal end inverted, proximal end implanted into side of jejunum behind transverse mesocolon Few adhesions remained from previous operation, healing of anastomosis excellent, no adenopathy present Recovery delayed by infection of wound which healed firmly

April 6, 1929—Has gained in weight and so much in endurance that she has been promoted to a position of added responsibility which she had been unable to occupy X-ray examination revealed no abnormality in size and peristalsis of stomach or in propulsive power of her gastro-intestinal tract

Comment—Had the duodenojejunostomy been performed at the first operation or soon thereafter, the rehabilitation of this woman's digestive apparatus and the restoration of her working capacity would have been more rapidly satisfactory (See Figs 1 to 8)

Stomach—Causes Inherent frailties in the muscularis or those acquired by overeating, rapid eating, and the excessive labor incidental to pylorospasm, antraspasm, duodenal stasis, and obstructions in more distant intestinal segments, grave anæmias, uræmia, appendicitis and cholecystitis

Effects (a) Local—hyperperistalsis followed by hypoperistalsis, dilatation, retention, and stagnation of ingesta, absorption of noxious substances, penetration of mucosa by bacteria, lymphangitis, and lymphadenitis, superficial ulcers, and alterations in secretions (b) Systemic—malnutrition, reduction in blood and tissue chlorides (alkalosis), toxæmia, pain and indigestion (c) Retrograde—vomiting

Treatment Appendectomy, cholecystectomy, alleviation of anæmia, uræmia, and correction of duodenal and more distal obstructions are more certain to be effective if suitable diets, rest after eating and avoidance of fatigue are included in the after care. Operations upon the stomach to relieve subcompetence must be adapted to the state of the duodenum. Pyloroplasty to relieve pylorospasm if the duodenum is, or is going to become incompetent is quite certain not only to fail but also to make bad conditions worse.

CASE V—I O school girl sixteen years of age. Well until six months ago, since then, pain three hours after eating refused to eat as directed. She has lost forty-three pounds. Physical and X-ray examinations indicated duodenal ulcer.

June 11 1923—Operation under combined gas and local anæsthesia. Stomach hyperirritable antraspasm dilated but supposedly not atonic. No duodenal ulcer could be found even on direct inspection of mucosa. Finney pyloroplasty performed after mobilizing duodenum.

June 23 1923—Immediate results of pyloroplasty were good but duodenal retention developed and a posterior gastro-enterostomy was performed.

July 2, 1923—Stomach emptying well through gastro-enterostomy stoma. Wound healing excellent but convalescence retarded.

January 20 1925—Following operation patient improved very gradually and intermittently until a few months ago. Then as the competence of her stomach returned, she rapidly regained weight and strength and is now quite well.

Comment—Partial atonicity of the duodenum became almost complete following pyloroplasty and necessitated a gastro-enterostomy which was contraindicated as a primary operation as was a low duodenojejunostomy. A high end-to-side duodenojejunostomy might have provided the needed relief.

Gastro-enterostomy may afford temporary relief but if the pylorospasm disappears, other and perhaps more serious mental and physical distresses are likely to follow. It is probable that when both stomach and duodenum are inert and pylorospasm absent, if any procedure should be employed it is a transection of the duodenum beyond Brunner's glands, closure of its distal end and implantation of the proximal end into the side of the jejunum. (See M. R., Case IV.)

Concurrence of Indurated Gastric and Duodenal Ulcers and Subcompetence in Stomach in Duodenum or in Distal Intestinal Segments—Three cardinal factors enter into the production of indurated ulcers—primary injury, repeated or continued irritation, and restricted blood supply, and of these ischemia is the most significant. Hyperemia occurs to a degree during the contraction of normal peristalsis, it is accentuated in hyperperistalsis and is most pronounced (ischemia) during spasm. Consequently only superficial, transient ulcers develop in segments after the muscularis has become atonic. Passive obstructions in distal segments tend to provoke hyperperistalsis in proximal segments. This explains why constipation so often precedes ulcers of the stomach and of the first portion of the duodenum which are liable to injury and also are subjected to the action of hydrochloric acid. Local irritation incidental to evolution of ulcers produces hyperperistalsis and spasm in the affected segment, and the resultant ischemia favors not only further induration of an existing ulcer, the development of other ulcers, but also leads to the fatigue of the muscularis and to ultimate dilatation and stagnation. Thus ulcers of the stomach, either along the lesser curvature or at the pylorus, and of the duodenum occur with or without subcompetence of distal segments, with and without gastric and duodenal subcompetence.

Operative treatment of gastric and duodenal ulcers is partially effective if it relieves symptoms, and fully effective if it removes the ulcer, reestablishes the gastro-intestinal gradient and thereby prevents the subsequent development of another ulcer or of other symptoms.

Conditions precedent to success of operations vary with the presence or absence of subcompetence in stomach, duodenum or in the cæcum which is the chief offender.

GASTRO-INTESTINAL SUBCOMPETENCE

in the proportion of individuals in whom constipation has been a contributory influence in provoking the ulceration

Excision of an ulcer along the lesser curvature succeeds if the stomach and duodenum are competent and there is no obstructive lesion in a distal intestinal segment. It is incompletely successful if only the stomach is subcompetent. Then a pyloroplasty is indicated. This would be contraindicated if there were passive obstruction in the duodenum. Under that condition a gastro-enterostomy would be necessary. Similarly, resection of a gastric ulcer near the pylorus combined with a pyloroplasty or a Billroth No. 1 is effective if the duodenum is competent, otherwise a Billroth No. 2 or a modified Polya is required. If incompetence is present, any form of operation is but part of treatment which should include every measure that can help to reestablish muscular tonicity.

Simple resection of duodenal ulcers and some form of plastic closure of the defect are satisfactory if the duodenum is competent. If it is incompetent, Billroth No. 2 or a transection of the duodenum with excision of the ulcer, inversion of the distal end of the duodenum and implantation of the proximal end into the side of the jejunum is demanded.

CASE VI—A R., housewife, twenty-eight years of age. Symptoms of duodenal ulcer for the past two years, lost weight and strength, more particularly in the past few months. Is now unable to keep house and care for children. She cannot gain because food and work reawaken her ulcer symptoms.

August 29, 1928—Laparotomy. No lesion in stomach. Tone good. Duodenum dilated and atonic, scar and stippling of serosa, ulcer healed. Duodenum transected at level of scar about three-fourths of an inch beyond pylorus, distal end inverted, scar and underlying mucosa excised, proximal end implanted into the jejunum behind the transverse colon.

October 24, 1928—Some antraspasm but stomach is empty in four hours. Can take unrestricted diet without distress.

March 5, 1929—Is not gaining in weight, because she has to work too hard. Is not losing, appetite is good, and there are no symptoms of any derangement of her gastro-intestinal tract.

Comment—This patient's experience so far would justify the assumption that implantation of the proximal duodenum which contains Brunner's glands into the jejunum is more wholesome than a gastro-enterostomy and less upsetting to the gradient if, indeed, it is not restorative.

None of the above procedures is ample if there is passive obstruction in distal segments which remains uncorrected. Gastro-enterostomy alone is inadvisable if avoidable because the ulcer is not removed, the gradient is not reestablished, and both may cause trouble. If gastric subcompetence is present, it demands at least as much consideration as the ulcer for until it is corrected, recovery is impossible.

The chief objective of operations is to remove the ulcer and, when feasible, the cause thereof, to reestablish the gastro-intestinal gradient rather than to restore the normal channel, to minimize injuring vessels and nerves in order to preserve muscular integrity and to promote primary union, thus restricting the cicatrix. End-to-end anastomoses are least harmful as they interfere little with the circular muscle, end-to-side anastomoses are more harmful, and lateral anastomoses most harmful because they divide the circular muscularis of both segments and, therefore, should be no longer than is necessary to provide an adequate stoma. The farther separated the segments which are anastomosed, the greater the differences in their propulsive power, and the more certain the backing upward in the distal segment as exemplified in ileosigmoidostomy.

Concurrence of Cancer of the Stomach and Subcompetence in Stomach in Duodenum and in Distal Intestinal Segments—There are two types of cancer—the spontaneous and the induced. The spontaneous form develops without obvious precedent irritation. Maude Slye's investigations and the studies of Warthin (*Jour. Can. Res.*,

vol 18, p 279, 1929) and others have proved that the predominant causative influence is inherited. Potts first recognized induced cancer, the scrotal epithelioma of chimney sweeps, provoked by the irritation of coal soot. Many other irritants are provocative, among them indurated ulcers. Systemic defense against both forms of cancer is identical qualitatively but not quantitatively (Yates and Raine, *Lewis Surgery*, vol 11, ch 9). Deficits in defense offered by patients suffering from spontaneous cancer are inherent and less likely to become effective after the growth is removed. Deficits in defense against induced cancer are imposed by the action of irritants and are more likely to become effective after the growth is extirpated even though the removal is incomplete.

Extirpation of spontaneous cancer should be more radical, and if complete extirpation is impossible, radical operations that are particularly hazardous should seldom be attempted.

Extirpation of induced cancer need be less radical, and, even though complete removal is unattainable, extensive operations are justified as some of these patients will survive for many years (ten to twenty) apparently recovered, before they suffer recrudescence.

Gastric and duodenal subcompetence and passive obstruction in distal segments may or may not be present with either form of cancer.

The chief problem is how to reconstruct the digestive tract after extirpation. Here, as after extirpation of ulcer, the indications are to reestablish the gastro-intestinal gradient, rather than to restore normal anatomic relationships. Again it is necessary to correct any existing passive obstructions in distal segments.

SUMMARY

Disturbances in the gastro-intestinal gradient caused by passive obstruction resulting from subcompetence of the muscularis of one or several segments occur alone or with gross lesions of the stomach and duodenum, appendicitis, and cholecystitis.

Early in the development of passive obstruction, while the muscularis can be rehabilitated, non-operative measures will so often be successful that they should always be employed and in conjunction with appendectomy and cholecystectomy if indicated.

Later, when the muscularis of certain segments has become irreparably atonic or after non-operative measures have been proved inefficacious, operative restoration of the gradient is indicated in patients of sufficient mental and physical stamina to be benefited. If such operations are performed, non-operative measures should also be employed before and after operation as they hasten recovery and prevent the development of similar lesions in other segments.

Operative treatment of ulcer and cancer of the stomach and of ulcer of the duodenum is more certain to afford immediate and lasting relief if the gross lesions are removed and the gastro-intestinal gradient is restored.

CONCLUSIONS

All functions of the digestive tract are largely commensurate with motility.

Preservation and restoration of the gradient are the objects of gastro-intestinal therapy.

GASTRO-INTESTINAL SUBCOMPETENCE

Fatigue and exhaustion of the muscularis are the lesions that impose hypoperistalsis and dilatation which cause passive obstruction

Passive obstruction is a frequent and serious disturbance of the gradient that should be remedied to rehabilitate digestion, prevent the development of other lesions in the gastro-intestinal tract and as a prophylactic measure against pulmonary, mesenteric, and retroperitoneal glandular and osseous tuberculosis

The existence or probable development of subcompetence in stomach, duodenum or in distal intestinal segments is a factor which should help to determine the nature of operations employed to relieve indurated gastric and duodenal ulcers and cancer of the stomach

THE SURGERY OF PYLOROSPASM

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THE surgical physiology of the pyloric sphincter bears an important relationship to peptic ulcer. Aberrant functions of the sphincter, such as achalasia (failure to relax) and spasm are considered to be due to disturbed innervation. The resultant changes in the chemism and motor function of the stomach are represented clinically by the syndrome of peptic ulcer. (This aspect of peptic ulcer was discussed at the 1928 meeting of the American Surgical Association by Martin and Burden.) It often happens however, that symptoms typical of ulcer occur where neither Rontgen-ray examination

nor laparotomy demonstrate the presence of ulcer. From this fact it may be assumed that the disturbed physiology is the cause and not the effect of ulcer. A logical corrective measure for the interference of disturbed pyloric function would be division of the nerve supply as practiced by Schiassi¹² and by C. H. Mayo⁸ or by direct attack on the sphincter through the operation advocated by Shoemaker and by Martin and Burden,⁷ in which the anterior half of the sphincter muscle is removed.

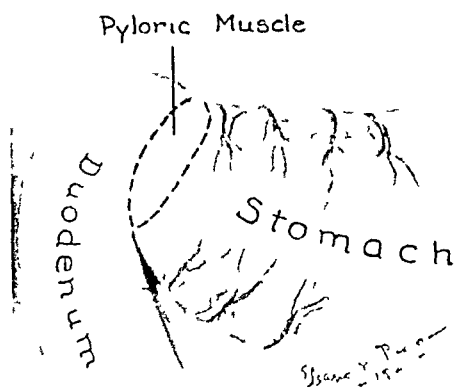


FIG. 1.—Removal of portion of pyloric muscle. First step. Lines of excision.

Although the operation on the pyloric muscle was originally devised for the relief of pylorospasm, in view of the afore-mentioned surgico-physiological relationship of the pyloric sphincter to peptic ulcer, it occurred to us to apply it to cases of duodenal, gastric, and gastrojejunal ulcer as well as to pylorospasm associated with hyperacidity or with disease of the gall-bladder and of the appendix. We herewith present the results of our experience with the operation which we have termed hemisphincterectomy pylori or pylorohemisphincterectomy.

Theory of the Operation—The hydrochloric acid of gastric juice is probably the most important single factor in the development and maintenance of peptic ulcer. The clinical studies of Bolton³ and Hurst,⁵ and the experiments by Boldyreff² and Mann⁶ are confirmatory. The nearest approach to clinical conditions was obtained by surgical duodenal drainage. By this method, Mann was able to produce typical peptic ulcers. In his experiments the chemism of the stomach was not significantly changed and the ulcers

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were not located in the duodenum but in the transplanted jejunum. These findings indicate that normal gastric juice will cause ulceration of the jejunum—a fact of no little significance in the etiology of gastrojejunal ulcer. By extending these experiments, Norton found that gastrojejunostomy performed after the appearance of the ulcer following surgical duodenal drainage, led to the prompt healing of the original ulcer and the formation of a new ulcer in the jejunum opposite the gastro-enteric stoma, a chain of events very closely simulating the clinical development of gastrojejunal ulcer.

In the development of duodenal ulcer, we may assume either that the duodenum has been rendered unnaturally sensitive to normal gastric acid through deprivation of its normal protective mechanism or that the concentration of hydrochloric acid leaving the stomach is beyond the endurance strength of the duodenum. From clinical and experimental studies the latter assumption seems to be the more tenable. Boldyreff's work, which has been confirmed by many others, showed that the gastric juice when secreted always contained about 0.5 per cent hydrochloric acid which normally is reduced to 0.2 per cent, the optimal strength for digestion. Experimental studies favor the opinion that regulation of gastric acidity depends on regurgitation of duodenal contents into the stomach, although the inherent capacity of the stomach to regulate its own acidity must be considered.

Elman's⁴ investigation of clinical cases of duodenal ulcer revealed a constant deficiency of duodenal regurgitation, which was probably caused by pyloric interference. Spasm of the pyloric sphincter and its failure to relax in coordination with gastric function, abnormalities not uncommon to sphincters elsewhere along the gastro-intestinal tract, may be assigned as a reasonable hindrance to duodenal regurgitation. Failure of duodenal regurgitation and the development of hyperchlorhydria permit the squirting into the duodenum of acid of injurious strength and the point of impingement of the stream becomes the site of an ulcer. The same theory applies to the development of gastric ulcer, in which the retention in the stomach of hyperacid gastric juice has been proven to cause single and multiple ulcerations.

After a gastrojejunostomy has been made for duodenal ulcer there is often a failure to note a change in gastric acidity, yet many of these patients remain well, a few will develop marginal ulcer. The latter lesion has been known to occur even when analysis finds a reduction in acidity. Such findings are significant. Estimation of gastric acidity by analysis of test meals, in our opinion, does not represent the true every-day working conditions in the

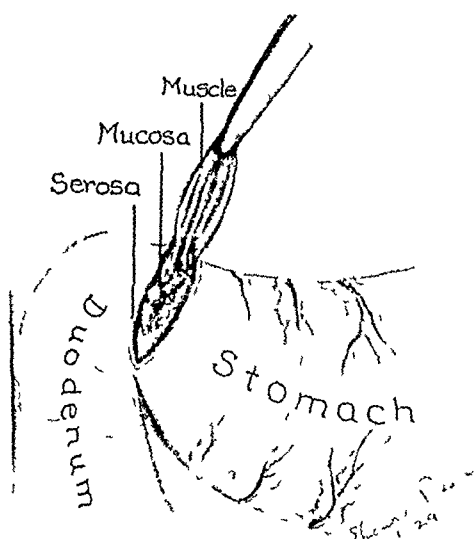


FIG. 2.—Removal of portion of pyloric muscle. Second step. Removal of muscle.

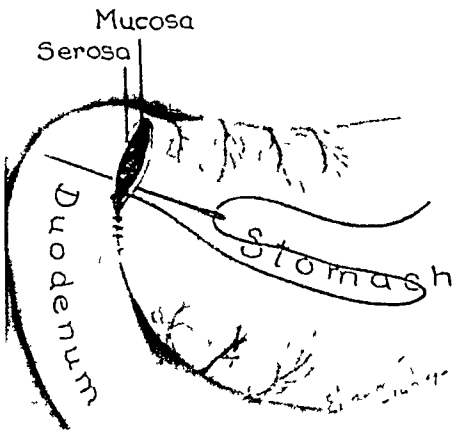
stomach When gastro-enterostomy is successful, there is regulation of gastric acidity by reflux of duodenal contents through a free and patulous pylorus or through the new stoma or through both openings However, for reasons not at present explainable, the onward current in the proximal loop may sweep past the gastro-enteric stoma and there will be no regulation of gastric acidity The latter condition is a potential marginal ulcer The jejunum is more sensitive to hydrochloric acid than is the duodenum so that it is possible for jejunal ulcer to develop from the effects of normal gastric juice

Appendicitis and cholecystitis are frequently associated with peptic ulcer to a degree that has aroused suspicion of a causal relationship The tracing of lymphatic paths between these foci of infection has fitted in nicely with the surgeon's creed that infection is the origin of most diseases However, we cannot disregard the frequent mimicry of peptic ulcer by disease of the

gall-bladder and the appendix in cases where the symptoms are explained by reflex pylorospasm By putting these phenomena in sequence we have disease of the appendix or of the gall-bladder, reflex pylorospasm, disturbance of acid-alkali balance at the pylorus, and finally, peptic ulcer

For the relief of pylorospasm in the absence of ulcer, Payr¹¹ and Bastianelli¹ incised the gastroduodenal area longitudinally down to the submucosa, an incision somewhat longer than in the Rammstedt operation They report satis-

FIG. 3.—Removal of portion of pyloric muscle. Third step. Closure of serosa.



factory results Resection of the anterior half of the pyloric sphincter through a double elliptical transverse incision naturally removes more of the muscle ring and renders less likely a resumption of the function of the sphincter, because its two ends are so widely separated that the small amount of interposed scar tissue cannot bring them together The senior author has, many times, made a longitudinal section of the muscle for pylorospasm when operating for gall-stone disease

Technic of the Operation—After opening the abdomen by an upper right rectus incision, the gastroduodenal area is exposed and held under tension by drawing the stomach out and to the left The pyloric sphincter may be readily located by the landmarks of the short, transverse veins, an elliptical area, including the anterior half of the sphincter, is formed by two curved transverse incisions, one on either side of the sphincter These incisions are carried down to the submucosa of the stomach and duodenum The lower end of the elliptical area, including the sphincter, is cut across and with the aid of the scalpel it is peeled off the underlying submucosa and again cut across at its upper extremity The resulting oval effect, exposing the submucosa, is closed by a continuous suture which unites the gastric and duodenal serous

THE SURGERY OF PYLOROSPASM

edges. Penetration of the submucosa should be carefully avoided, especially on the duodenal side and should it occur, the opening must be securely closed by suture. Wide extension of inflammatory œdema or of scar tissue from a nearby ulcer are contraindications to this operation because of the difficulty of placing holding sutures in such pathologic tissue. Ordinarily the ulcer is not disturbed, but in a few instances we have deliberately excised the ulcer in addition to removing the anterior half of the sphincter. In three cases of acute perforation of a duodenal ulcer we have closed the perforation and then resected the sphincter. When the operation has been properly performed there is no appreciable narrowing of the pyloric outlet, although this occurred in one of our early cases and required a secondary gastro-enterostomy to relieve obstruction. The defect remaining after removal of the oval piece of tissue containing half the sphincter should be closed to control oozing from the incised edges and to avoid the chance of leakage, because the duodenal submucosa is very thin.

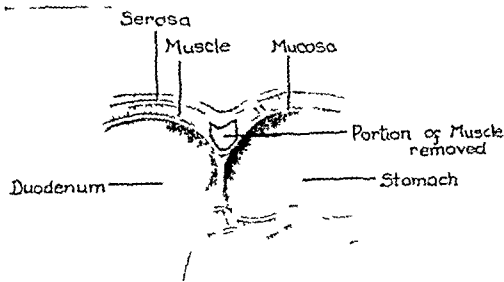


FIG 4—Section through stomach and duodenum showing portion of pyloric muscle removed

SUMMARY OF CASES

Thirty-one patients were operated on of whom twenty-seven were males and four females. The ages by decades were eight in the third, thirteen in the fourth, four in the fifth, five in the sixth, and one in the seventh. This series of cases is obviously too small to warrant conclusive statements. It is not offered for comparison with the results of other procedures used in peptic ulcer, but merely as a record of our experience.

All patients gave a more or less typical history of peptic ulcer, six having a history of hæmorrhage. The duration of symptoms ranged from one week (acute perforation) to twenty years. An X-ray examination of the stomach and duodenum was made in sixteen cases and reported positive for ulcer in eight.

Operative Findings—Duodenal ulcer was found in twenty-three cases of which three were acute perforations. Gastric ulcer was found in three cases of which one was an acute perforation, nine had cholecystitis, seven of which had an associated duodenal ulcer and two pylorospasm. Pylorospasm was found in four cases, two with cholecystitis, one with appendicitis, and in one it was the only finding. One patient had a gastrojejunal ulcer.

Operative Procedures—The anterior half of the pyloric sphincter was excised in all cases. Additional operative procedures included excision of duodenal ulcer in four cases, gastrojejunostomy in one case, cholecystectomy in nine cases, sleeve resection of the stomach in two cases. One patient died in the hospital from uræmia. Of the remaining thirty patients, eighteen reported to the follow-up service. Of these, fifteen, or 83.3 per cent were completely relieved of symptoms, two reported marked improvement,

and one only moderate relief. X-ray studies made after operation in twelve cases showed no gastric retention, no hyperperistalsis and only slight deformity of the pyloric canal. In one case the stomach emptied more rapidly than normal. Analysis of fractional test meals were made in nineteen cases before operation and showed the usual varying values for free and total acidity. Fractional test meal studies were made by Doctor Engel in eight patients in the follow-up service and found to be within normal limits, in no instance was there an absence of free hydrochloric acid. In our experience gastric analysis has been of little help either in the diagnosis or prognosis of peptic ulcer. In this connection, we believe Morton's work in gastroduodenal analysis seems promising. He found that in cases of peptic ulcer and of pyloric achalasia the duodenum always contained free hydrochloric acid while in normal controls it was absent.

CONCLUSIONS

Thirty-one cases are reported in which the anterior half of the pyloric sphincter was removed for the relief of duodenal ulcer, gastric ulcer, gastrojejunal ulcer, and pylorospasm.

The high percentage of beneficial results following this minor anatomical procedure seems to justify its more extended use.

The theory of the operation is based upon correction of malfunction of the pyloric sphincter.

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THE MANAGEMENT OF RECURRENT ULCER FOLLOWING PARTIAL GASTRECTOMY

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A YEAR ago I reported before this association a group of fifty-three cases of recurrent ulcers following partial gastrectomy. These cases were divided into three groups: (1) twenty-eight cases in which the ulcer was found at operation, (2) twenty cases in which a clinical or roentgenologic diagnosis (or both) of recurrent ulcer was made, but chiefly because of mild symptoms the patients did not come to operation, and (3) five cases in which the subsequent course pointed definitely to recurrent ulceration or was suggestive of it. The cases in which the ulceration was found at operation were classified according to the type of primary resection and to the lesion for which the primary operation had been done. Since this report three patients with recurrent ulcers following partial gastrectomy have been operated on at the clinic, making a total of thirty-one cases found at operation at the clinic.

There are certain inherent difficulties in the treatment of these cases. They are chiefly based on the fact that a characteristic of peptic ulcer is recurrence, a tendency which is, in some respects, more marked than in any other disease. The control of this tendency to recur is accomplished with variable success by medical and surgical measures, and it is a tribute to surgical treatment that an adequate operation, in cases in which it has not been possible to prevent recurrence by medical treatment, usually is successful. There are some patients, however, in whom recurrence occurs in spite of radical surgical procedures. In these cases recurrence is due, in all probability, to an exaggeration of the normal tendency to recur rather than to the addition of new causative factors, although the latter is possible.

There are certain difficulties, also, in the evaluation of symptoms which develop or persist after partial gastrectomy. In the first place recurrence of dyspepsia does not necessarily mean the presence of ulcer, the symptoms may be due to other disease, either intra-abdominal or extra-abdominal. The symptoms also may be a result of mechanical imperfections in the anastomosis, or to disturbances in gastric function, which are quite independent of any recurrent lesion. Recurrence of symptoms also may be due to localized inflammatory processes without the actual formation of ulcer, in such cases symptoms may simulate closely those of ulcer, although the pain is rarely as severe as in ulcer. Difficulties in diagnosis also are encountered by the roentgenologist, since deformity from a previous operation will easily confuse interpretation, to make a positive diagnosis on roentgenographic data is hazardous as the irregularities visualized may be due either to deformity or to actual ulcer.

Difficulties continue to be found in determining the best method of treat-

ing patients in whom recurrence of symptoms suggestive of ulcer have developed after partial gastrectomy. If patients manifest mild symptoms, even with positive roentgenographic evidence of a crater, continuation of non-surgical measures may be advised until all other possible means of relief have been definitely exhausted. The dangers of delay must be appreciated, however, since a recurring ulcer after partial gastrectomy more frequently will be associated with serious complications than a primary ulcer, and the complications are much more difficult to deal with than those which accompany primary ulcer. Usually, however, the symptoms are so severe, and expectant treatment has been proved so inadequate that little choice remains as to further management and operation must be performed.

The difficulties of medical and of surgical treatment in these cases are well known. It is frequently found that if recurrence has developed, particularly after more than one resection has been done, the patients do not display the willingness to cooperate, which is so desirable. Some patients obtain relief by the use of sedatives and some, by taking milk at half-hourly intervals. In many cases, long-continued distress, loss of sleep, and deferred hope have brought about complete disability. I have been told repeatedly by this type of patient that a cigarette relieves tension, so that some of these patients become cigarette addicts. In some cases the pain becomes so severe or so persistent, particularly at night, that the patients have resorted to opiates and become habitués.

Response to medical treatment in cases of recurrent ulcer is less likely than in cases of primary ulcer. I am not convinced that this is always because in recurrent ulcer, the symptoms are more severe or that the possibility of quieting the activity of the ulcer is less than in primary ulcer, but rather that the long-continued disability and particularly the repeated disappointments have brought about hypersensibility to pain. It is a temptation to try every nonsurgical means suggested for the control of recurrent ulcer. The use of vaccines has not, in my experience, been followed by any definitely good results. The application of Röntgen-rays to reduce gastric acidity has been tried experimentally, and to a slight extent clinically, but, so far as I know, permanent good results have not been obtained. It is important to eradicate all foci of infection before deciding that the lesion will not heal.

Weir has demonstrated recently certain facts in relation to acidity, his data are based, in most cases, on repeated fractional estimations of gastric content, and, in some cases, on aspiration of gastric content at the time of maximal pain. Of the twenty-nine cases of recurrent ulcer following partial gastrectomy, achlorhydria was present in 20 per cent. In 40 per cent, gastric acid was definitely reduced, and in 10 per cent only was high acidity demonstrated. This appears to be sufficient evidence that elimination of gastric acidity does not necessarily protect the patient against further ulceration.

The surgical treatment of recurrent ulcer following partial gastrectomy cannot be conducted on the same basis as that employed in primary ulcer chiefly because the patient already has demonstrated that in his case there

is a distinctly higher liability to recurrence. The purpose of operation for primary ulcer is not only to relieve the patient of the symptoms of the ulcer, but to protect him against recurrence. If both objects can be obtained by a conservative operation, so much the better. The fact that recurrence takes place in such a small percentage of cases after a properly performed conservative primary operation, based on adequate indications, means that if relief of symptoms can be accomplished by a conservative operation, there is little justification in doing a radical operation. This is particularly true in view of the fact that more radical primary procedures do not assure protection against recurrence.

Incomplete operation for ulcers that recur following partial gastrectomy probably will fall in its dual purpose, that is, relief of symptoms and protection against further ulceration. However, further resection is often technically very difficult, and the surgeon is confronted with a most serious problem both from the patient's standpoint and from his own.

There are two types of such recurrence in which a conservative operation may be warranted. First, are recurrences following the Billroth No. 1 type of resection or of its modifications. In these cases particularly, if obstruction or impending obstruction is present, gastro-enterostomy may bring about complete and permanent relief of symptoms. The advantages, therefore, of an indirect procedure in such cases should not be lost sight of, particularly if the patient is in poor condition or if the inflammatory process is extensive. Second, are recurrences in which a protected perforation has occurred following an extensive resection of the Billroth No. 2 type with wide involvement of surrounding structures in the inflammatory process. Preliminary jejunostomy in such cases will bring about marked regression of the inflammatory process and will permit carrying out a radical procedure with much greater safety as a secondary rather than as a primary procedure.

In all cases other than these, secondary resection is indicated. The technique of secondary resection does not require description before this Association. There are certain general principles, however, which are worthy of mention. It is most important, for example, that trauma, particularly to mucosa of the stomach and jejunum, be reduced to a minimum. I am convinced that some recurrences can be attributed to devitalization of mucosa near the line of anastomosis. A second principle is that a radical change should be made in the type of gastro-enteric anastomosis. A third principle involves the use of a jejunostomy tube for feeding in cases in which the lines of anastomosis have been difficult to establish. A fourth principle is that such patients must realize that every possible contributing factor to the tendency to recurrence should be eliminated. Tobacco and alcohol should be prohibited, foci of infection should be eradicated, a most meticulous dietary regimen should be maintained, and proper adjustment of bodily activity and relaxation should be made. The maxim of such patients should be "Alternate rest and labor—long endure."

DISCUSSION

DISCUSSION DR GEORGE W CRILE, of Cleveland, Ohio, said that any discussion of this subject always brought out the limitations which both medical and surgical attack, in the last analysis, reveal. He hesitated to introduce any new facts on a subject of this kind.

In hypothyroidism and myxœdema hydrochloric acid is low or absent while in hyperthyroidism hydrochloric acid is high. Nervous excitation and adrenalæmia tend to increase the acidity of the stomach. Associated with hyperacidity is an increased motility.

Doctor Crile mentioned that Miss Amy Rowland, Dr J I Farrell, and he had tested the following hypothesis. Hydrochloric acid is always present in the stomach, and the small intestine is alkaline throughout the entire biologic series, this alkalinity being assured by the pouring into the duodenum of the highly alkaline bile and pancreatic juice.

The acid stomach and the alkaline intestine, therefore, form a great biologic battery, consisting of the acid gastric juice and the great area of alkaline intestines separated by the innumerable cells in the intestinal and stomach walls which thus constitute a dielectric partition.

Such an hypothesis is readily tested by measuring the potential between the stomach and the intestine.

This measurement has been made, and there is found a large difference in potential between the interior of the stomach and the interior of the intestine, amounting to approximately 25 millivolts. Such an active, biologic battery would create a continuous electrolysis, especially at the pole of highest potential. Such a battery would tend to break down the gastric wall by electrolysis, in other words, it would produce and maintain a gastric or duodenal ulcer, and an increased motility.

Among the excitants of increased acidity in the stomach and of hyperthyroidism is adrenalin. Experimentally, adrenalin exerts a profound effect on the potential of the gastric side of the theoretical battery and has but slight effect on the intestinal side.

Now, in a resistant post-operative, recurrent case of hyperthyroidism it was found that unilateral adrenalectomy and resection of the cervical sympathetics stabilized the patient beyond the effect of the thyroidectomy alone. Therefore, it is proposed in a case of intractable gastric or duodenal ulcer to perform a similar dekineticizing operation relieving the patient partially of his accelerating mechanism, bringing down permanently the difference of potential of the great intestinal battery, hence lowering the electrolysis, and lowering the motility, the latter probably being one of the functions of the gastro-intestinal battery.

DR ARTHUR D BEVAN, of Chicago, Ill., remarked in regard to technic of operations for pyloric stenosis: "I rather think the Rammstedt operation has been developed so that one might speak of it as one of the most finished products in modern surgery. We are doing all of these operations under local anæsthesia. I think that is tremendously important.

"Most of these children go to sleep under local anæsthesia if they are

given a nipple and a bottle, if the local anæsthesia is properly handled. In order to prevent the escape of the abdominal contents during the operation, there is an anatomical fact in connection with the operation which is very important. It is this. In the child the liver comes pretty well down below the costal arch. The infiltration should be made in the right rectus and the incision should be made so that two-thirds or three-fourths of the muscle is left on the outer side. Then as you open this incision with retractors you come down to the liver. The liver should be the one structure that fills this entire field, and the lower part of the peritoneum should not be divided.

"We found in quite a series of cases that this technic has prevented the escape of any of the abdominal contents and made the operation simpler. The liver then is lifted up, the stomach is pulled into view, and the operation is performed. In dividing the tumor we have found that it is simply necessary to divide the peritoneum and then to do the rest of the dissection with very small forceps, a mosquito forceps or a small artery forceps. In that way you can avoid injuring the duodenum.

"We do not attempt to divide anything but the peritoneum. Then we spread the tumor apart down to the submucous layer, and bring out the mucous tube without any further division.

"The third point that I should like to emphasize is the importance of preventing a possible evisceration some days after the operation, because wound repair is very often very slow in these little starved children. At the end of ten days you may not have any more wound repair than may occur in a normal child in three or four days, so that provision against evisceration must be maintained for about twenty days. This is best obtained by adding to the ordinary closure of the incision two or three small button sutures which can be left in fifteen or even twenty days if necessary."

DR ALLEN O WHIPPLE, of New York City, reported the results at the Babies' Hospital of New York in the treatment of pyloric stenosis in infants.

The total number of cases that were operated on at the Babies' Hospital was 648. Of these Doctor Downes' and Doctor Bolling's cases, together, number 584, Doctor Bolling having performed the larger number, 384.

The total mortality for the whole series is a little less than 5 per cent. Doctor Downes wishes to emphasize particularly that in Doctor Bolling's private cases, 76 in number, the mortality was 2.6 per cent.

In recent years at the Babies' Hospital the operative mortality in pyloric stenosis has rapidly decreased, owing to the fact that this condition is better understood generally, and the patients come to operation in better shape than formerly. It is also due to the fact that treatment before and after operation is better understood. The liberal use of transfusions and saline solution have aided materially in obtaining these improved results. The technic of the operation as done follows the original Fredet-Rammstedt method. Late results in cases done as long as fifteen years ago show that these patients are restored to normal health by this simple operation and develop in every way as well as other children.

DISCUSSION

A further report shows that sixty-four cases have also been done by Doctor Donovan at the Babies Hospital, with a mortality of less than 6 per cent

DR LIONARD FREEMAN of Denver, Colorado, discussing Doctor Brown's paper on hypertrophic congenital pyloric stenosis, said that the causation is not clear in everything that he had read on the subject. It is usually attributed to spasm in the pyloric muscle, and that seems to be a very reasonable solution. Yet there are objections to this. Spasm occurs in a good many muscles in the intestinal tract. It occurs very frequently in the pyloric muscle and yet a tumor does not develop. Spasm occurs also in the cardiac opening of the stomach and yet we see no tumors. Anal spasm is a very common thing, lasting for a long time, yet tumors of that muscle develop.

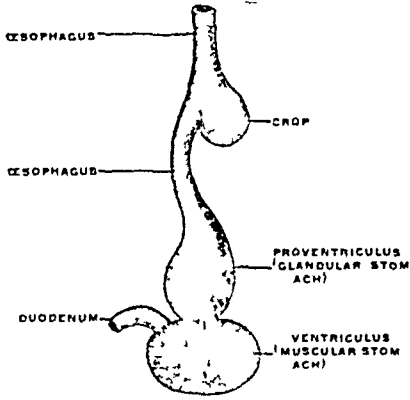


FIG. 1—Anatomy of the human peritoneum, Huntington, 1903

In the next place, these tumors in pyloric stenosis in infants appear very shortly after birth. They are found a few days after. They have even been found at birth, and they have also been found, a number of times, in the foetus before birth. It is very difficult to understand how pyloric tumor could develop in such a muscle without having some length of time to do so. Also it is not known that spasms occur in the pyloric muscles of unborn infants. To this may be added what Doctor Brown has said—that these muscles do not disappear after the symptoms disappear and the patient is supposed to be cured.

If these tumors are not due to muscular spasm what are they due to? It occurred to Doctor Freeman some years ago—and he stated he has spoken of it elsewhere—that they were probably reversions to an ancestral type. These throwbacks to ancestral types are quite common in the gastro-intestinal tract as is known. They can all be referred back to some animal in a lower line of existence. If that is so, then what animal is of particular interest?

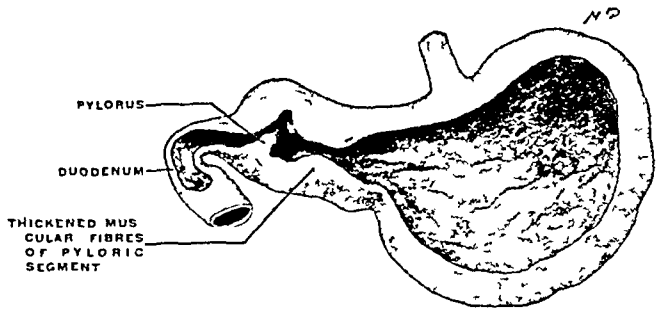


FIG. 2—Anatomy of the human peritoneum, Huntington, 1903

Take for instance the granivorous birds. The gizzard in these granivorous birds is situated in exactly the same spot as the pyloric tumor under discussion. Also, in some of the rather higher mammals, the same sort of thing is found. In the animal called the colored anteater, for instance, there is a stomach. The outlet of the stomach is occupied by a heavy muscular

tumor in the same situation as the tumor in hypertrophic pyloric stenosis. This is a suggestion of causation.

DR J. SHELTON HORSLEY, of Richmond, Va., spoke of recurrence of peptic ulcer after operation, or after medical treatment, which is always interesting. Doctor Finney has shown that it recurs frequently after medical treatment. Other analyses of series of medically treated ulcers have appeared in the *American Journal of Medical Sciences* some time ago. These show an even more impressive percentage of recurrences.

He said that it seemed to him unfortunate to divide the treatment of ulcers of the stomach into medical and surgical treatment. There must be medical treatment in all of the cases, and there must be surgical treatment in some of them. The type of treatment that is adopted may have something to do with it. Dragstedt, some years ago, showed that the best way to make an experimental peptic ulcer in a dog was to put a series of sutures in one portion of the pyloric mucosa. This mucosa secretes alkaline material and is peculiarly liable to development of peptic ulcer. He has been doing a pyloroplasty for a good many years, and he found a great number of recurrences at first, as many as 25 per cent. He tried to trace cases accurately. The recurrence was along suture lines. He put in sutures and tied the knots in the pyloric mucosa. Usually the recurrence has been at the end of the suture line where the knots were. Since that experience, he has abandoned suturing the pyloric mucosa, and has dispensed with the inner row of sutures. He sutures the peritoneal and muscular coats of the stomach, catching the vessels on the submucosa, and when the duodenum is reached the whole wall of the duodenum is caught in the suture. At the upper portion of the wound the suture merely approximates the peritoneal and muscular coats of the stomach—again taking care not to clamp the gastric mucosa of the pylorus with forceps. This method controls the bleeding satisfactorily.

He is using the pyloroplasty in a more restricted field than at first. He thinks, however, that it has a definite field. In cases in which there is persistence of a small, sharply marked ulcer of the first part of the duodenum, without adhesions or surrounding infiltration, this operation seems indicated.

Since using the operation in a rather restricted field, he has had no real marked recurrence except in two cases, and those cases were easily cured by medical treatment. If the recurrence were a jejunal ulcer after gastroenterostomy, instead of a duodenal ulcer after pyloroplasty, the situation would be much graver.

In regard to the operation that Doctor Deaver described, he is wondering what the later results will be. If you take out a part of a sphincter it probably repairs by connective tissue. That connective tissue tends to contract. It contracts more readily in some areas than in others. The profession knows there is a proneness for stricture to occur at the pylorus and such a stenosis is often very difficult to cure. Then after this operation the posterior part of the sphincter with its nerve supply is left intact. It might be better to divide the sphincter ends and interpose the gastric wall as in the pyloroplasty.

he had mentioned, or to destroy at least a portion of the nerve supply of the pylorus by the procedure of Walter Hughson, who resects some of the gastric branches of the vagus nerve, which is easily done. Certainly there would be no danger of stenosis after either of these operations.

DR WILLIAM D HAGGARD of Nashville, Tenn., supported what Doctor Bevan had said about the usefulness of local anaesthesia in the infants with pyloric stenosis.

He did his first case in 1916, and since then has had no occasion to use any other type of anaesthesia. He has had no difficulty with evisceration. As a matter of fact, the little people do not make very much fuss. He thinks it is not any worse for them than when they have their ordinary change of raiment.

He wants to call attention, too, to an unusual complication that can occur. The profession thought when it got past haemorrhage and peritonitis that all of its dangers were gone. But Doctor Haggard recently had a fatal issue from alkalosis in an infant that had been carried along by feeding for a prolonged period of six weeks. Although the operation was very satisfactorily concluded, within twelve hours the infant had major convulsions followed by a number of smaller ones, and though every agency to overcome the alkalosis was employed he perished. He even went so far as to use the parathyroid injection with the hope of establishing the calcium metabolism and thereby make the base for his acid production. It is the only time he has heard of post-operative alkalosis after the Rammstedt operation.

DR WILLY MEYER, of New York City, said that at the coming meeting of the American Gastro-enterological Association, which is to take place at Atlantic City within a few days, a discussion on the cause and management of recurring gastric ulcer after partial gastrectomy is on the program. One colleague is going to report that in ten patients the left vagus nerve was divided from the abdomen, with the intention of reducing the recurrence of pain and intense acidity. Those patients remained cured. Of course, it would be better if fifty or sixty such cases could be reported instead of ten. If corroborated by others, more favorable reports will appear quickly. The operation is not difficult technically.

He mentioned this, because it has been his impression in operations on the stomach, also after gastro-enterostomy, that the gastric and the entire sympathetic nervous system play an important rôle during the immediate and later after-treatment.

He thought it deserved to be mentioned in this discussion that in ten cases of this resection of the left vagus nerve, done premeditatedly, there had been observed no recurrence of pain and hyperacidity.

DR JOHN C OLIVER, of Cincinnati, Ohio, said that Doctor Brown's reference to a case of congenital pyloric stenosis reminded him of a case which he reported to this Society six or seven years ago, and gives him the opportunity of reporting on the man's condition at the present time.

This man was fifty-one years of age at the time. He made a diagnosis

of pyloric stenosis of the congenital type with a great deal of fear and trembling. He also did a Rammstedt operation with a great deal of fear and trembling. He is glad to say that this man, at the present time, seven or eight years afterward, is perfectly well and has gained forty pounds.

DR CHARLES H. MAYO, of Rochester, Minn., said that he believed the primary cause of ulcers of the stomach was acids. Next he looked on them more and more as having to do with the sympathetic nervous system. Various changes in circulatory conditions would have to be present in order to have the several factors that would be necessary for an ulcer to develop.

We talk of the healing and recurrence of ulcer. He does not believe that any ulcer that has given two or three periods of trouble heals at all between the attacks, whether there is pain or not. In the old varicose ulcer of the leg there is perhaps a similar condition. In these cases, there is a big sore that looks painful but which does not cause pain. One man with a varicose ulcer said that usually he had no trouble at all. However, "When I am laid up," he said, "there is a purple spot around the thrombotic area. I cannot walk. I have to keep it hot and I have to keep still. There is a little red spot on one side."

The little thrombus is at the margin of the ulcer that is getting larger. As this spot appears, pain comes on and the symptoms of ulcer develop.

Years ago he cut the nerves around ulcers of the leg. For about three years he has been cutting nerves in cases of gastric ulcer. Leriche has been running a knife around the stomach at the pyloric end, about an inch and a half above the pylorus, and cutting the sympathetic nerve supply. After doing a good many for a year, he was operating one day and one of the roentgenologists, standing by him, asked him what he was doing. He said he was cutting the innervation, to see if he could relax the pylorus. The roentgenologist said, "You should go above the angle of the stomach. An ulcer at the angle of the stomach will produce more spasm than an ulcer in the pyloric end of the stomach or the duodenum."

He began to cut the big right vagus nerve, and the gastric artery, cutting through the lesser omentum halfway between the cardia and the angle of the stomach. But this does not interrupt all of the vagal supply, because, as in the Leriche operation, in which the outer coat is peeled from a section of the artery of the leg to eliminate the sympathetic supply of the artery in the lower part of the limb, many fibres of the sympathetic nerves are supplied to the artery at lower levels and relief is, therefore, for four or five months only. By cutting as he has described, all the tissue, including the artery, would be severed. Nevertheless, if the fingers are inserted under the short side of the stomach and pull is exerted on it by lifting it a little, creases will be found. Each one of them is caused by a thread-like nerve fibre that is as strong as silk. The vagus nerve has branched higher up and the branches have spread out. A number of fibres will be found. You can work the knife through them until they pop.

Doctor Hartzell studied the effect of section of the vagus nerves in dogs

DISCUSSION

In some animals, he sectioned the vagus nerves just above the diaphragm and found that there was a marked reduction in both free and total acidity. In other animals, he sectioned the vagal branches in the abdomen and found that although the free acid was somewhat reduced the secretory curve was shorter, and the stomach emptied more rapidly.

Doctor Mayo finds that by cutting the nerves in the human being he has caused reduction of acidity. It takes many years to know what you are doing and to determine whether it is going to be better than anything else. But it is interesting to see that the acids are lowered by the procedure he has outlined.

DR JOHN L. YATTS, of Milwaukee, Wis., remarked that there are a few facts that merit emphasis. Subcompetence of gastric or intestinal segments is the result of lesions in the neuromuscular apparatus. Purely functional disorders are a myth. Subcompetence causes passive obstruction which interferes with digestion and impairs morale, and even when not associated with ulcer demands correction. A majority can be corrected without operation, but when this is impossible, operations are indicated only in the patients of some physical and mental stamina.

When subcompetence and ulcer of the stomach or duodenum coexist, the subcompetence is possibly incidental but more often is either the cause or the result of the ulcer. If causative, subcompetence occurs in distal intestinal segments, provokes retrograde hyperperistalsis in stomach or duodenum and thus contributes to the development of ulcer. If consequential, subcompetence occurs in stomach or duodenum, the result of previous hyperperistalsis incidental to the development of the ulcer, and contributes to stasis or retention.

Disturbances in the gastro-intestinal gradient cause indigestion, restoration of the gradient relieves indigestion. If intestinal subcompetence contributes to the development of ulcer, it is futile to treat the ulcer and neglect the cause.

There are three objectives in treating patients suffering from ulcer: (a) Relief from symptoms, (b) removal of the lesion, and (c) restoration of the gradient. If gastric or duodenal subcompetence coexists with ulcer, the operation of election removes the ulcer and restores the gradient rather than normal anatomic relationships. We believe, therefore, that subcompetence of gastro-intestinal segments is therapeutically significant either as an independent lesion or in causal or consequential relationship to ulcer, and that inasmuch as maintenance or restoration of the gradient is the objective of gastro-intestinal therapy, subcompetence must be duly considered in all aspects.

DR DONALD C. BALFOUR, of Rochester, Minn., said he believed that such operations as Doctor Deaver has described and those which are designed to simplify the management of peptic ulcer are very well worth while. The simpler the method by which the symptoms of ulcer can be permanently controlled, the better it is for the future of the patient.

The second point is one which he mentions with some hesitation, since

GASTRIC SURGERY

everyone recognizes the place which Doctor Finney holds in the field of gastric surgery. Any figures which Doctor Finney presents carry the weight of authority. It would be most important, therefore, to know the cause of death of these patients, and also to know whether the primary diagnosis was finally established. It seems astonishing that such a high death rate should have occurred in the first six months after indirect operations for duodenal ulcer.

Twelve years ago insurance actuaries showed that in 3000 patients who had been operated on for duodenal ulcer, the life expectancy was actually better than that of the general population group of the same age and sex. This is at such variance with the figures presented this afternoon that it seems probable that reconsideration of the cases Doctor Finney has included in his statistics would disclose an explanation for the discrepancy between the two reports.

PROCESS OF UNION AFTER FRACTURE

By FREDERIC W. BANCROFT, M.D.

OF NEW YORK, N. Y.

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IN THE repair of fractures there are certain steps in the process that we know, and there are other phases about which we must theorize until our knowledge increases. It would seem advisable to present before this Association the things we know and the things we surmise.

We know the gross steps of repair—that is hæmorrhage resulting from the injury—the later output of callus, at first gelatinous in consistency and

later becoming calcified, with resultant union. Microscopically we have observed the hæmorrhage, the ingrowth of wandering cells, the formation of granulation tissue, and, later, the ossification of this connective tissue.

We do not know, although we may surmise, the exact type of cell that enters into this reparative process. We do not know the particular activity of this cell. We know little

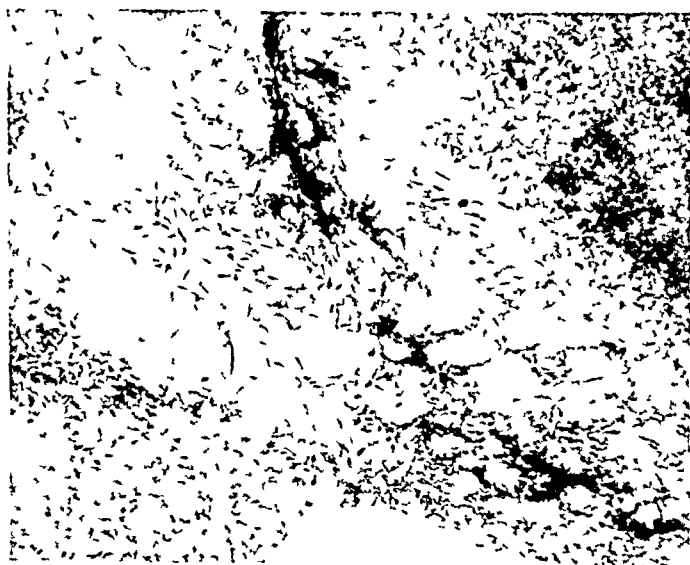


FIG. 1.—Curetings three days after fracture of patella. Note fibroblasts invading blood clot, beginning calcification of stroma.

of the physicochemical changes that turn calcium and phosphorus into bone.

Therefore, it would seem advisable to review briefly what we know about the healing in fractures, and then to attempt to build up from the various theories a working hypothesis which will be of service in the clinical treatment of patients with broken bones.

What We Know About Repair in Fractures—Gross Description of Repair. Any force sufficient to break a bone, whether it be by direct or indirect violence, must by necessity injure the neighboring soft tissues—muscles, blood vessels, lymphatics and frequently nerves, skin and subcutaneous fat.

In our rabbit experiments the femur was broken with a single tap of a hammer. No immobilization of the leg was attempted. On inspection ten hours later the muscles were badly traumatized, hæmorrhage extended between muscle bundles and along fascial planes often to an astounding dis-

PROCESS OF UNION AFTER FRACTURE

tance from the source of injury. In the muscle bundles the hæmorrhage seemed to bulge the fibres out, which would account for the difficulty in replacing fractured ends some time after injury.

When this experimental fracture was examined ten days after injury there was overriding of the fragment and an extensive callus formation which surrounded the broken ends and extended well out into the muscles. It was

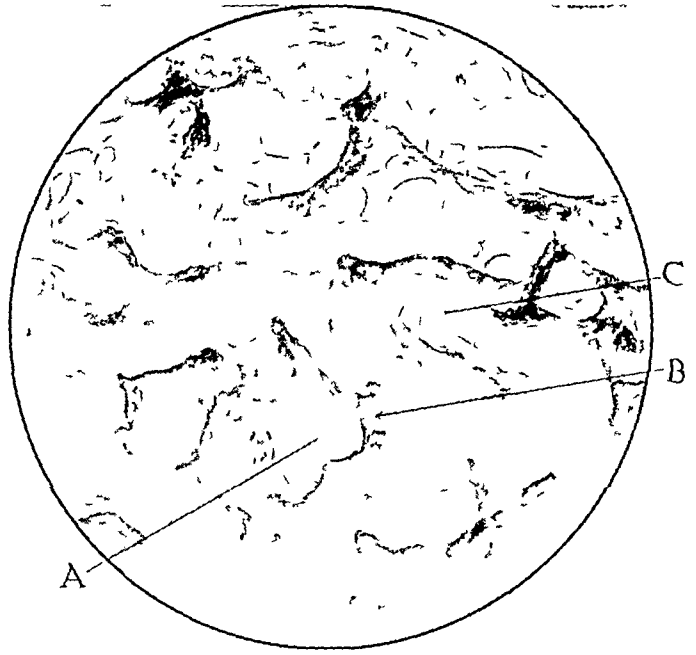


FIG 2.—Artist's sketch of nine day callus. Note arrangement of blood vessels, areolar tissue and callus. A, Blood vessel; B, Callus; C, Connective tissue.

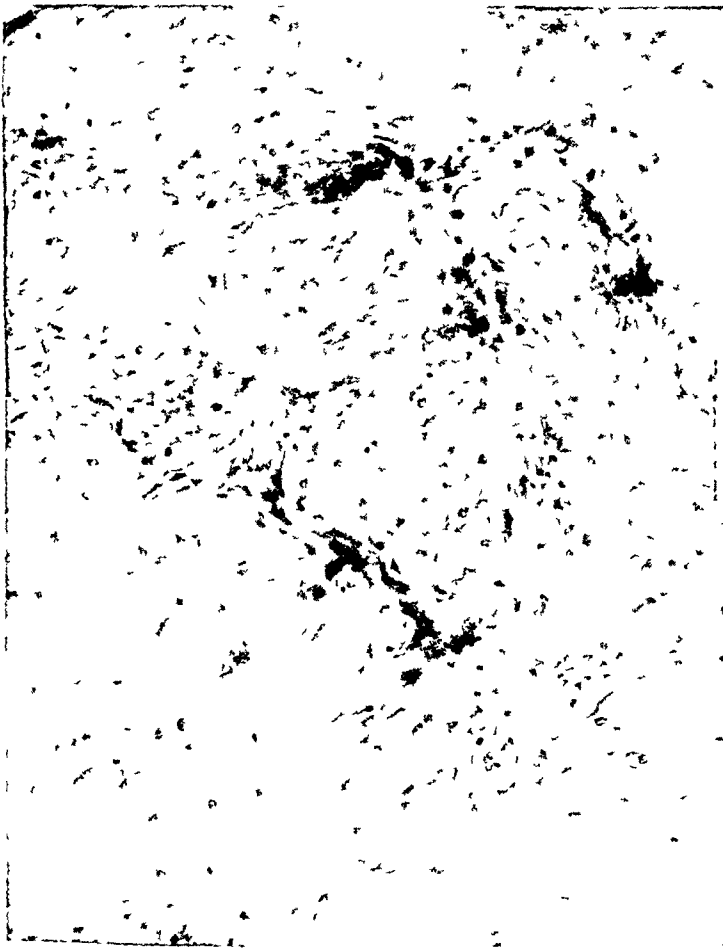


FIG 3.—Photomicrograph of eleven day callus. Note arrangement of blood vessels, areolar tissues and callus. The trabeculae tend to form about capillaries and the 'bone cells' are apparently formed by the inclusion of fibroblasts in the bone forming process.

possible to move the fractured ends in an angular zone, but even with the skin and surrounding muscles removed it was almost impossible to use sufficient force to bring the fractured ends in apposition and correct overriding.

This gelatinous consistency of the callus explains the difficulty experienced in attempting the late reduction of fractures under anaesthesia by manual traction.

On cutting this callus with a knife a distinct grit of the tissue could be felt. The areas where there had been hæmorrhage showed pigmentation and gradual absorption of the clot. Later

examinations revealed union with overriding and dense infiltrative callus

Microscopic Examination—Immediately after injury torn muscle fibres are seen with hemorrhage extending out through the muscle bundles and following fascial planes

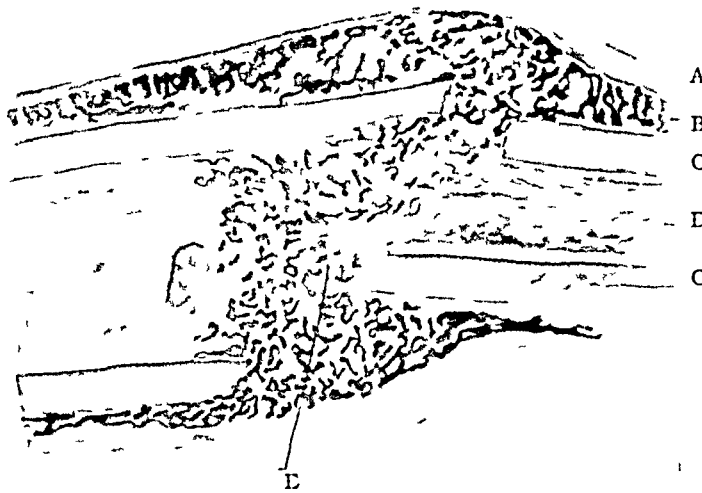


FIG 4—Artist's sketch of twelve-day fracture showing callus beneath the periosteum, penetrating the medullary cavity and extending outward toward the muscles. A, Periosteum B, Periosteal bone C, Cortex D, Medulla E, New bone, with haversian system at right angles to shaft

the bone cells in the immediate vicinity (Fig 8) There were also areas where decalcification had occurred and apparently small spaces formed in the bone Surrounding the fractured ends there had been a definite ingrowth of tissue suggesting granulation

tissue The vessels ran in general at right angles to the cortex and apparently they had grown in from the periosteum and the muscle structures at the periphery and had also grown outward from the vessels in the medullary canal A somewhat definite pattern was visible which suggested a structure almost comparable with the lobules of the liver That is, one could see a blood vessel and around it an area of areolar tissue and beyond this at the periphery an area of deposition or secretion of osteoid material (Figs 2 and 3) This osteoid tissue surrounded and

incorporated the cells in its immediate neighborhood and it was always in the avascular areas In places there were dense areas of cartilage cells in which there were irregular darker staining areas, apparently due to increased calcification In the zones where cartilage, connective tissue and bone joined there was a gradual transition in the appearance of the cells (Fig 7) It was impossible in these transitional zones to determine the exact character of the cell involved

Some sections examined showed a surprising amount of free blood dissecting between the muscle bundles in the direct neighborhood of the fracture Sections three C to five days after fracture showed fibrin formation in the clot in the region of the fracture with connective tissue cells beginning to infiltrate the fibrin Here and there could be seen small areas which stained more densely, showing beginning ossification (Fig 1) Sections examined ten days after fracture showed rarefaction of the cortex in the neighborhood of the fracture with absence of nuclei in



FIG 5—High power view of curettings removed from a twelve-day old fracture of human femur At the periphery of the section in the new fibrous tissue, remnants of striated muscle are seen caught in the callus See Fig 6

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This osteoid tissue surrounding the fracture zone often extended well out into the muscle bundles, and was seen transversing the zone between the fractured ends and through the medullary canal (Figs 4, 5 and 6)

In sections taken three to four weeks after fracture, osteoid tissue was seen to be gradually assuming the characteristics of the haversian canal systems. The proliferation of the osteoid tissue occurred at the expense of the areolar tissue immediately surrounding the vessels. The exuberant callus had lost its osteoid staining characteristics and more closely resembled scar tissue. Where the periosteum had been stripped from the bone the vessels of the osteoid tissue ran at right angles to the long axis of the shaft.

Sections of linear fractures observed eight months to one year following fracture showed the reestablishment of the medullary canal

and the reestablishment of the normal alignment of the shaft when proper reduction

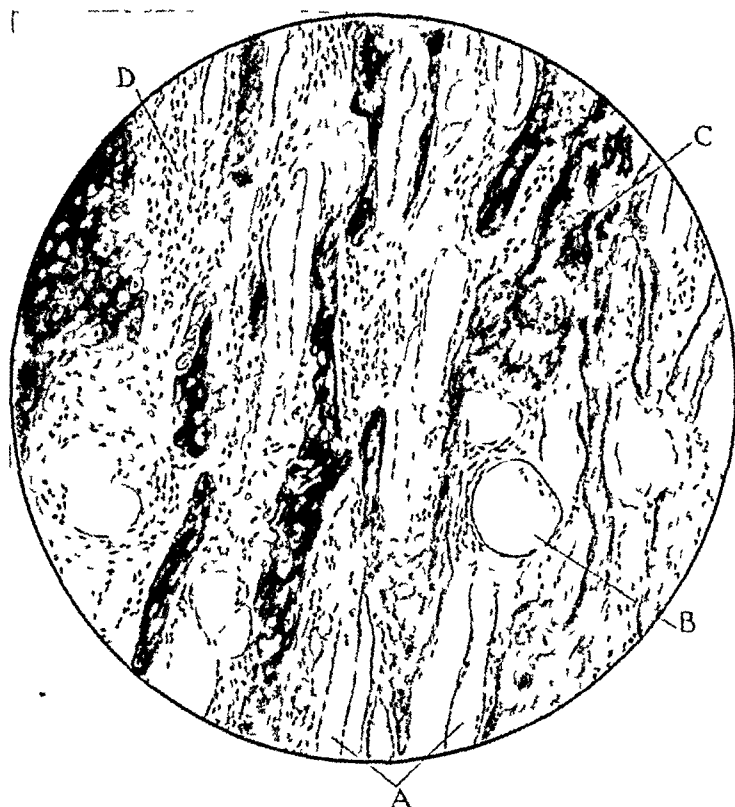


FIG 6—Artist's sketch of high power view of Fig 5 Twelve day human fracture A, Muscle fibres B, Blood vessels C, Callus

had been performed. The haversian canals in the fracture area ran at right angles to the shaft in contradistinction to the normal parallel arrangement of these canals. The reestablishment of the normal alignment of the haversian canals apparently proceeded by so-called creeping replacement.

In comminuted fractures where fragments had been entirely separated from their blood supply, no nuclei were observed at two weeks following fracture. At four to five weeks following fracture the haversian canals of these fragments contained blood vessels with apparently living red blood cells. Imme-

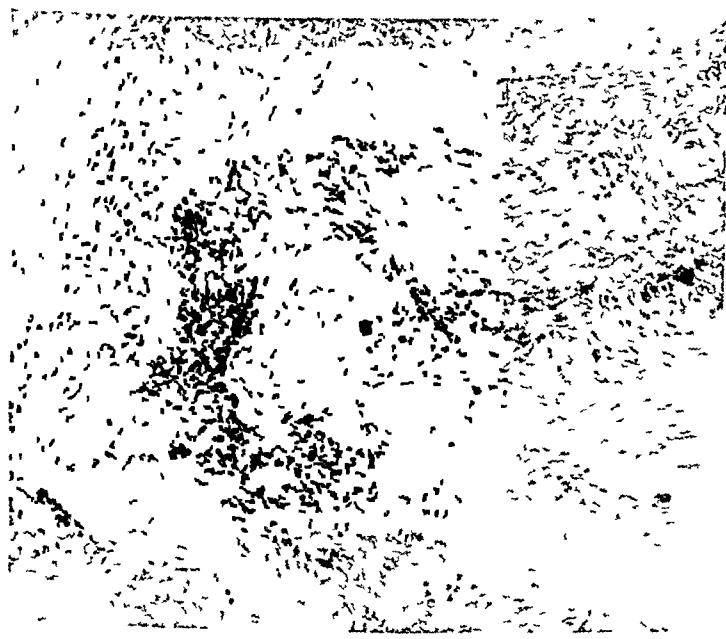


FIG 7—Fracture of dog's humerus, seventeen days. There was overriding of the fragments. Note gradual transition of connective tissue cells to bone cells.

diately surrounding these haversian canals one to two layers of bone cells with active staining nuclei were observed. Elsewhere no nuclei could be seen (Figs 10 and 11)

At eight months to a year it is impossible to identify fragments on microscopic sections. Here and there areas of bone wherein the nuclei do not stain suggest the location of the bone fragments. It is reasonable to assume

that these fragments have acted as an extensive source of calcium and that the vascular channels in these fragments have been utilized by the granulation tissue in the formation of the new bone.

I believe that the processes above described occur in fractures in the normal process of repair. We know these various stages. We do not know the origin of the cell that enters into the primary osteoid tissue. Various authors attribute the origin of this cell to (1) Osteoblasts which are set free by the fracture, (2)

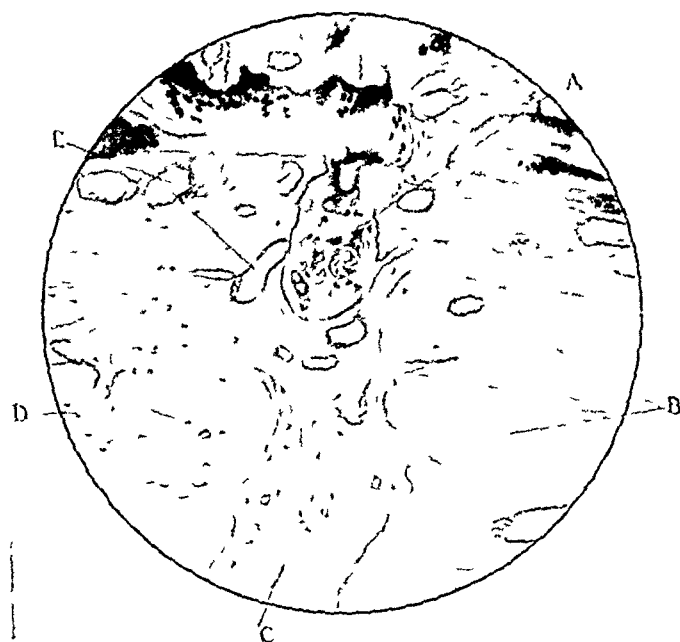


FIG 8—Artist's sketch of two weeks' fracture in dog. Linear fracture immediately treated. Note absence of nuclei in cortex and demineralization. Ingrowth of callus perpendicular to shaft. A, Cartilage; B, Adjacent cortex with destruction of nuclei; C, Callus; D, Normal cortex; E, Cyst formation in cortex—bone atrophy.

to cells arising from the periosteum and endosteum, and (3) to osteoblasts which arise by a process of metaplasia from fibroblasts.

Considerable work has been done in recent times to throw doubt on the existence in adult life of any specific cell having osteoblastic function.

I believe that too great importance has been placed on the nature of these cells, except from a standpoint of academic interest.

From a study of the repair of fractures in human subjects as well as in experimental animals it is my conviction that the future of the repair of a fracture depends almost entirely on the immediate local treatment that the patient receives and very little upon the systemic metabolism of the

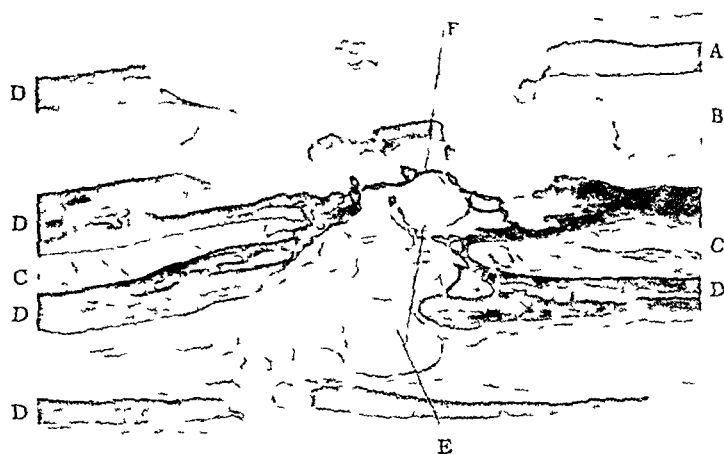


FIG 9—Three weeks' fracture of radius and ulna in rabbit. Immediately treated by too tight circular plaster. Failure of repair. A, Cortex; B, Medullary canal; C, Interosseous membrane; D, Cortex; E, Cyst formation—failure of ingrowth of granulation tissue; F, Slight attempt at union.

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individual That is, if a fracture is immediately treated in a manner which will replace as far as is feasible the fractured ends in suitable apposition and allow for the organization of the clot and the ingrowth of granulation tissue with its accompanying vessels, repair will inevitably follow

Clinically, this means that if a fracture is so treated that there will be no constriction or obstruction to its blood supply and that there is sufficient immobilization to allow the ingrowth of granulation tissue without its being constantly broken up and interfered with by the movement of the rough fractured ends of bone, repair will proceed in an orderly manner

The Things We Do Not Know About Bone Repair—I We do not know the origin or the function of the cells that enter into the primary osteoid tissue Numerous experiments have been performed by transplanting periosteum alone, and bone without periosteum These have been inconclusive because of necessity some bone would be attached to the periosteum and some endosteum lining the haversian canals would be transplanted with bone fragments

Bone may be produced experimentally in almost any part of the body Microscopically it is bone, and grossly it resembles living bone Neuhof, in experiments at Columbia University, found bone almost universally in fascia lata transplants which he had used to fill defects in the bladder It would seem that any theory which accounts for bone repair must account for experimental and pathological bone It is hard to account for experimental or pathological bone by any theory which presupposes that the osteoblast is a specific cell that must arise from either the periosteum or from part of the cortical bone As bone is a connective tissue it would be more reasonable to

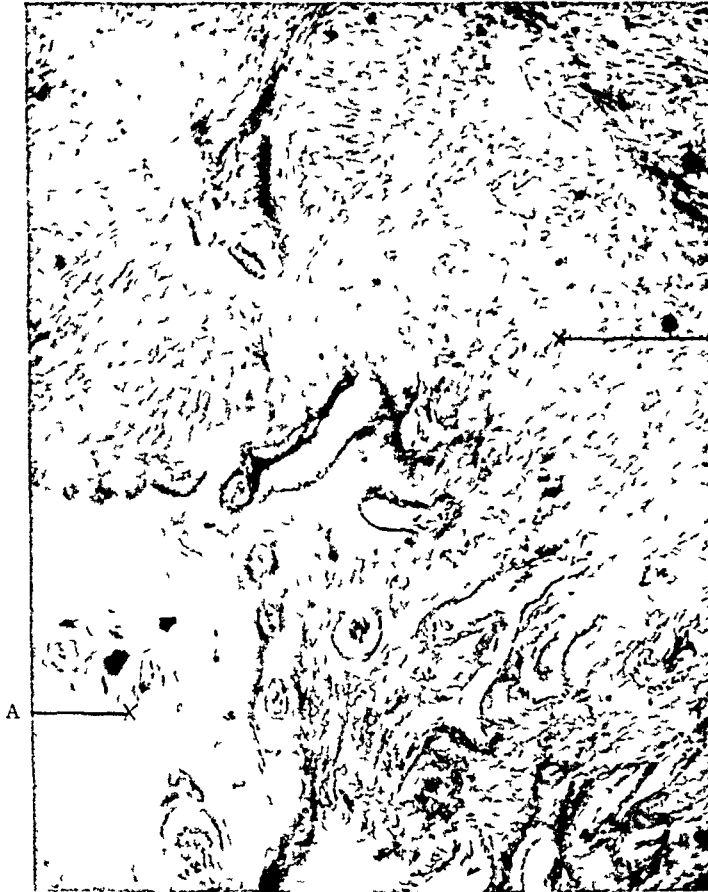


FIG 10—Comminuted fracture of dog's radius 141 days after injury Note bone proliferation about fragment with union Nuclei in fragment do not stain save in immediate vicinity of haversian canals A Bone fragment B, Cortex near fracture zone C, New formed bone about fragment

assume that the so-called osteoblasts may be fibroblasts which, by metaplasia, are transformed into bone cells

2 We do not know the particular activity of the bone cells We are not certain, although we may surmise, what action the cell has upon the production of bone It may so synthesize in its metabolism phosphorus and calcium, that it is transformed into the triple calcium phosphate—the main

mineral constituent of bone On the other hand the cell may be a pacific agent and be caught in the precipitation of the calcium and phosphorus elements on the intercellular stroma of connective tissue



Wells has stated that the mineral ash of areas of calcification and areas of ossification are the same, that there is a fixed proportion of carbonate to phosphate, of 15 parts by weight carbonate and 85 parts by weight of phosphate Pauli and Samec have shown that calcium carbonate and phosphate are soluble in an albuminous solution in seven times or more the amount of their solubility in water, so that they could be transported in this form in the blood

Wells believes that a

salt known as tribasic calcium carbonophosphate is carried to the seat of fracture by the blood and is precipitated on account of the low carbon dioxide content in this zone

Watt in recent studies of calcification and ossification has shown that in areas of calcification, where there are no cellular elements, deposition of the calcium salts has occurred in minute spherical bodies and crystalline masses as would physically occur in the deposition of minerals In areas of ossification, however, he believes that, as the new bone has a homogenous appearance, it is physically impossible for it to be a straight precipitation He states "(1) Calcium phosphate and calcium carbonate show characteristic easily-identified shapes of particles when precipitated in colloids, (2) the bone salts are not present as discrete particles in bone, and even in rapidly-growing parts, show no evidence of being deposited by simple precipitation, (3) Barille has shown that calcium salts are transported to the bone in the form of a complex double salt, calcium carbon-phosphate, (4) evidence favors the view that the salts in bone are deposited by activity of the osteoblasts, as a secretory phenomenon"

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It has been shown that calcium phosphate and carbonate may be carried by the blood stream in sufficient quantities to provide for ossification. Incomplete experimental work now being carried on at the College of Physicians and Surgeons of Columbia University would seem to afford the basis for the possibility that the source of calcium for fracture healing is essentially the site of fracture, and that the blood stream is not necessarily involved as a calcium source. The calcium in the skeleton is more or less in a position of flux. In certain cases of pancreatic fistulas and in breast milk it has been shown that calcium is utilized from the skeleton. X-rays of bone immobilized for any period of time show the demineralization which occurs from disuse.

It is well known clinically that a comminuted fracture produces more callus than a simple fracture. Experimentally if the comminuted fragments in such a fracture in a dog are removed, boiled, and replaced, union occurs in normal time and normal manner. If the fragments, on the other hand are decalcified before replacing them fibrous union occurs, but no calcification of the stroma takes place.

In our studies of the ends of bones in the region of fracture there is sufficient evidence to warrant the belief that the calcium necessary for the callus may be taken from the immediate vicinity of the fracture.

Colloidal combination or involved inorganic calcium compounds have been presumed by the majority of experimental workers as the form in which calcium exists in the bone or in the blood stream. It is suggested that calcium and phosphorus in the bone or blood stream may exist as an organic compound of tremendous molecular size, and they are allied with a carbohydrate radical, such as a calcium hexose phosphate. Such a combination might be split off from the tremendous molecule of which it is a part by the activity of a hexose-splitting ferment. The latter might be the product of a specific osteoblastic cell, or might be freed by the death of connective tissue cells of any non-specific type. Such ferment activity would be markedly affected as to its rate by relatively slight changes in the P_H of the surrounding medium. Bone formation, whether the result of fracture, chronic soft part disease, or of experimental efforts, is invariably accompanied by both qualitative and quantitative circulatory changes. Here is a factor which might be used to explain local changes in the P_H of the tissues at the site of bone production, sufficient to account for the variation in the degree of activity of any hexose-splitting ferment such as has been described above. The work on this phase of the question is at present in a rather chaotic state and the matter presented here is to be viewed in the light of possibilities which have aroused considerable thought.

Let us now see if we can clinically adjust a working hypothesis for the treatment of fractures, from conclusions drawn from the things we know and from the things we surmise in the treatment of fractures. The most important factor for the union of fracture is to have the fractured ends in close apposition and to have an adequate blood supply to allow the ingrowth of

granulation tissue with the resultant ossification to form callus. It appears, therefore, that the clinical handling of a fracture should be centred more upon the local and immediate treatment of the injured limb than upon the general metabolism of the individual. In rickets, which is perhaps one of the most noticeable metabolic diseases of bone, non-union after fracture is a relative rarity.

It is not our purpose to neglect the treatment of the patient. Obviously fresh air, sunlight, good food and, later, physiotherapy are important adjuncts in the general treatment of the individual. It is, nevertheless, the purpose of this paper to stress that the immediate local treatment of the injury is the most important factor in the cure of the individual.

Clinical Deductions from a Study of Bone Repair —1 The ideal treatment of a fracture should be the replacement of the fractured bone in as nearly perfect apposition as is possible. Union occurs with less output of callus and therefore less infiltration of the surrounding muscles where the periosteum is broken. When apposition is mechanically perfect there is consequently less interference with muscular activities.

2 The immediate replacement of fracture is advisable because several hours after fracture the swelling due to hæmorrhage which infiltrates the muscle bundles is so excessive that replacement becomes difficult. Overriding is difficult to correct because the longitudinal fibres of the surrounding muscles are so ballooned-out by the hæmorrhage that sufficient extension for replacement is almost impossible without creating greater trauma. Often extremities have to be suspended for several days in order to allow subsidence of the swelling before reduction can be attempted. As a result primary granulation tissue is interfered with and non-union may result.

3 Our primary effort in the treatment of a fracture must be to allow adequate circulation. Robinson has shown that, "since muscle is in a colloidal solution, albeit retained in its form by its sheath or its other fibrous interstitial structures it will have the physical characteristics of a fluid. The pressure in and about muscles is greatly increased by the trauma and resultant hæmorrhage. This pressure may be resisted by heavy layers of tissue and by tightly applied splints, bandages and adhesive plaster or cases. If resistance to expansion occurs, its effect will be to diminish or occlude the lumen of the arterial blood vessels, and thus prevent an adequate supply of blood from reaching the fracture zone." If this persists for any period of time granulation tissue is readily transferred into scar tissue, which is the worst enemy of union.

4 In cases where reduction is not attempted for several days the gelatinous consistency of the callus interferes with the manual correction of overriding. Only long-continued traction may correct the deformity.

5 Operative treatment of fractures. The ideal for operative treatment of fractures should be accurate replacement of fractured ends with the least possible trauma to the surrounding parts and the introduction of the smallest possible amount of foreign body to maintain replacement. Immobiliza-

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tion by external means, such as splints, cases, etc., must be so applied that the resultant swelling will not interfere with the necessary blood supply

(a) Internal fixation of fractures by bone grafts. In order to have a successful graft three conditions must be met, first, the graft must maintain the shape of the limb, second, it must have its blood supply quickly reestablished, and, third, it must stimulate osteogenesis in the neighboring tissues. In general, the smaller the graft the more apt it is to stimulate osteogenesis about it, and the more likely it is to have its blood supply quickly reestablished. McWilliams, in a thorough analysis of the various methods of bone grafting, read before the American Surgical Society in Toronto in June, 1921, came to the conclusion that the presence of periosteum upon the graft had very little influence upon its ultimate success. He analyzed about 1390 cases in which grafts had been used. Of these, 1170, with 82.0 per cent of successes, had periosteum, while 196, with 82.6 per cent of successes, were without periosteum. Clinically, it would seem more rational to transplant the graft with periosteum attached because vascular adhesions of connective tissue to connective tissue (connective tissue of the host with connective tissue of the periosteum) probably occur quicker than the vascular adhesions of connective tissues and bare bone.

(b) Where foreign bodies, such as plates or screws or nails, are introduced to maintain a fracture in apposition by operative means, osteogenesis is inhibited in their immediate neighborhood. If operative treatment of fractures is to reach its ideal it must perfect these mechanisms. In fractures of the radius and ulna the relative size of the foreign bodies introduced to maintain alignment are frequently out of proportion to the size of the bone. It is the belief of the author that non-union occurs too frequently from this type of treatment because osteogenesis is interfered with to too large an extent. Surgeons seeking ideal results must devise an improved operative technic for this type of injury.

(c) Fractures in children differ essentially from those in adults in that anatomical displacements of fractured ends often unite without resultant deformity. In children, bone is much more pliable than in adults and fractures occur when bone growth is active. The studies of late results show that often where there has been overriding of at least one inch, X-rays taken several years later show no shortening and it is often impossible to see the line of fracture. If we bear these facts in mind many unnecessary open operations on children will be avoided.

6 The problem of non-union is not discussed in this paper for the reason that Cowan gave an excellent presentation of this subject at the last meeting of this Association. The author agrees with his findings, except perhaps in some minor academic details.

IS ACCURATE REDUCTION OF A FRACTURE NECESSARY?

By ASTLEY P. C. ASHHURST, M.D.

OF PHILADELPHIA, PA.

THE question that has been assigned me by the committee on this fracture symposium bears a certain resemblance to that popular but unanswerable question of not so many years ago namely, "How old is Ann?" It is a question that cannot be answered without some preliminary limitation and definition. On the face of it, two obvious answers present themselves. Is accurate reduction necessary? (1) of course! and (2) of course not!

It becomes my duty, then, to attempt to define which fractures do, and which do not require accurate reduction. And it is of course, first necessary to have a clear understanding of what is meant by "accurate reduction." I think we must all agree that it means anatomical restitution of the fragments to the position they occupied before the fracture occurred, and their maintenance in that position until consolidation has taken place. This is what our Fracture Committee in 1915 understood by the term "good anatomical result" (*Trans Amer Surg Assoc*, vol XXIII, p 784 1915).

MEANS BY WHICH ACCURATE REDUCTION MAY BE SECURED

1 *Manipulation and locking of the fragments* may be attempted, usually with the patient anesthetized, in such fractures as are more or less transverse and in which it is evident that the fractured surfaces can be kept in apposition either by the aid of splints, or by means of the position in which the limb is dressed. This method applies especially to such injuries as supracondylar fractures of the humerus, fractures of the radius above the wrist ("Colles"), fractures of the neck of the femur (intracapsular), and most fractures around the ankle. It is more difficult to secure reduction by manipulation in fractures in the shafts of long bones than it is in fractures near joints, and even if secured, it often is impossible to maintain it by position or by splints.

2 *Open reduction with or without internal splints* may be attempted when efforts have failed to secure reduction by manipulation and locking of the fragments. In some cases, in which it is well known that attempts at closed reduction usually are unsuccessful, resort may be had at once to open reduction. Such, I believe, are cases of fracture of the shaft of the radius, the ulna being intact, and the fragments of the radius being transposed—by which I mean that the fractured surfaces do not face each other, but are placed back-to-back, so that union probably will not occur.

After reduction has been secured by open incision, I believe the use of an internal splint usually is desirable, unless the fragments are so shaped that they are very firmly locked, and unless the surgeon is very sure of being able to maintain reduction by his external splints and dressings.

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3 *Continuous traction until consolidation* is a method of securing and maintaining reduction adapted to fractures whose fragments are of such a shape, or so much comminuted, that they cannot be locked in position even after reduction has been secured. It is the method of treatment which I find particularly suitable for fractures of the shaft of the femur, and of the shaft of the humerus. In the femur, weight traction is used, but in the humerus the force of gravity usually is sufficient both to secure fairly accurate reduction and to maintain it, the patient being ambulatory, and the wrist only (not the elbow) supported by a sling. Of course, in both cases suitable coaptation splints are employed also, and in cases of fracture of the shaft of the humerus care must be taken not to allow overcorrection of the shortening to occur, since this favors delayed union or non-union. In most fractures of the leg and ankle I find the Delbet method entirely satisfactory both for reduction and retention, reduction is secured by continuous traction (without manipulation) in a very few minutes, and is then maintained by accurate adjustment of moulded plaster-of-Paris splints. (Ashhurst and Crossan *Trans Amer Surg Assoc*, vol xli, p 594, 1923.)

DISADVANTAGES AND DANGERS OF REPEATED ATTEMPTS TO REDUCE

Reduction should be secured within a few hours of the injury, at this time it usually can be secured without difficulty. If the surgeon postpones reduction, he finds it increasingly difficult to secure, because the reparative processes of nature will not wait on his convenience. Delayed and, especially, oft repeated attempts at reduction not only do great injury to the soft parts, but are quite apt to hinder the progress of union, with the result of delayed union, or even of non-union. Water which is constantly agitated will not easily freeze.

Union is the first desideratum. malunion is less of an evil than non-union, though of course firm fibrous union in good position may give the patient a more useful limb than monstrous deformity with bony union. I have in mind an aviator during the German War, who had firm fibrous union in a fracture of the humerus, without any deformity. He continued active flying for many months under the belief union was bony, and with no disability, finally coming under my care at the Walter Reed General Hospital for refracture which was shown at operation to have occurred not through bony union, but through fibrous union. I have also seen more than one patient with only fibrous union of the shaft of the radius, with angular motion easily detectable while the muscles were relaxed, but which when splinted in the midst of a tightly contracted muscular mass become as rigid as iron. But, I repeat, malunion of moderate degree is less of an evil than non-union, and I unhesitatingly declare that it is better to leave almost any fracture without accurate reduction than to secure the latter only at the expense of firm union.

I know that there are some who will regard this as pernicious teaching and who believe it is dangerous to let it be known that anything short of

accurate reduction ever can be satisfactory But I am here to tell the truth, and I cannot believe that the truth on such a subject as this can do any harm

What degree of reduction is sufficient? The answer to this question depends upon (a) the site of the fracture, and (b) the age of the patient

In general terms it may be stated without fear of contradiction that those fractures which do well even without accurate reduction are those that occur *in the shafts of the long bones* (some distance from the joints) and *in the young*, especially those under six or seven years of age These limits may even be extended in individual cases (1) Fractures near to joints do not always require accurate reduction in the very young, (2) even in some adults accurate reduction is not necessary in some fractures of the shafts of long bones For, after all, what we aim to secure is return of function, and it is an undisputed physiological law that form depends upon function, and not function on form The bones of the young are capable of vigorous

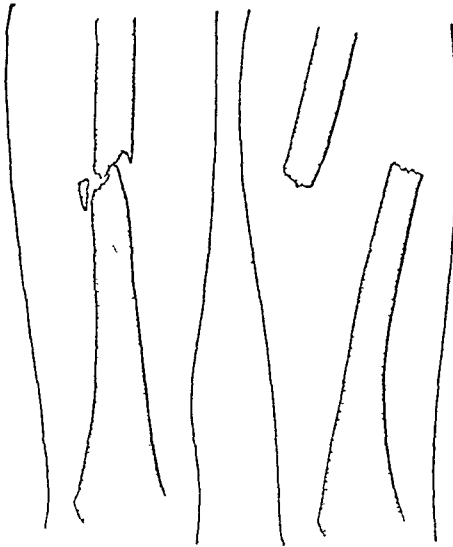


FIG 1—Case I Milton Gunson seven years Fracture of shaft of femur X rays after attempts to reduce under anesthesia Open reduction planned Ward placed under quarantine for scarlatina No operation See Figs 2 and 3



FIG 2—Case I Two months after injury Callus bridges the large gap Firm union

growth and remodeling, in response to the call of function, and it has been shown by Ridlon,[†] Truesdell (ANNALS OF SURGERY, vol LXIV, p 498, 1921, *ibid*, vol LXXXVIII, p 909, 1928), and others that accurate reduction may be actually detrimental in fractures of the shaft of the femur in childhood, resulting in eventual lengthening of the limb If the fragments had been left with a very little overlapping in the first place, the subsequent overgrowth, due to the stimulation from the injury, would merely have equalized the length of the limbs, and would not have made the fractured bone longer than normal For many years, in cases of fractures of the diaphysis, I have been satisfied with approximate reduction So long as bony union is secured,

* Ridlon (*Amer Jour Orth Surg*, vol VII, p 522, 1909) Two and one-half years after open reduction of a fracture of the femoral shaft in a girl eight years of age, the limb was two and one-quarter inches (6 centimetres) too long

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and the shortening is inappreciable, and so long as the axes of the fragments are restored nearly to normal, I have never yet failed to secure com-

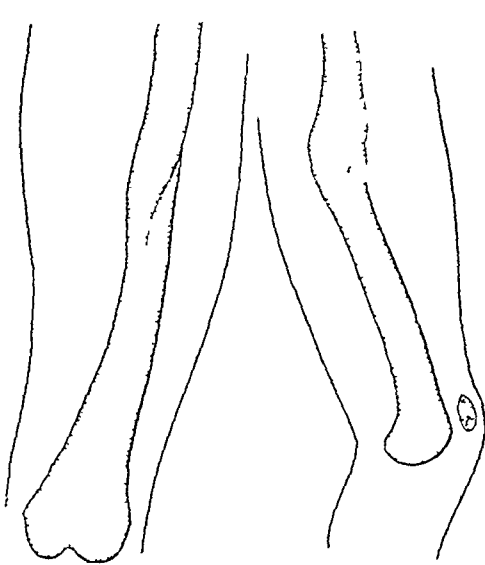


FIG. 3—Case I Six months after injury
Normal function for last two months



FIG. 4—Case II Ruth Ross
Fracture of shaft of femur in
an infant three months old
From X ray made sixteen days
after injury Union with right
angle deformity

plete return of function, and in children eventually a restitution nearly of the normal form



FIG. 5—Case II Six years later Be-
fore the child was old enough to walk spon-
taneous correction of the deformity had
occurred

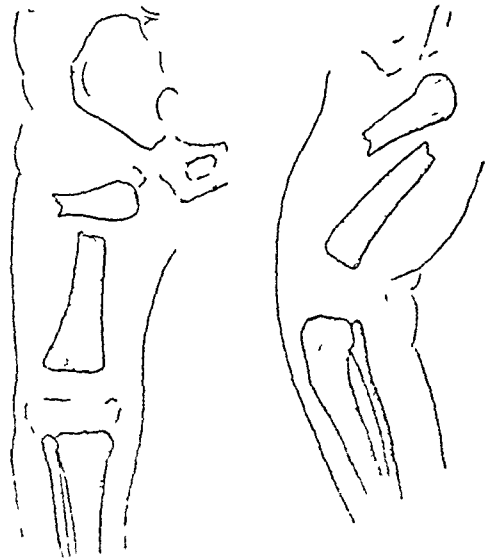


FIG. 6—Case III Bennie Sherwin Frac-
ture of shaft of femur during obstructed de-
livery Position of fragments after dress-
ing

CASE I—M. G., boy seven years of age, simple fracture of shaft of femur, run over by wagon November 1, 1914. Condition of soft parts bad. X-rays after attempted reduction under anesthesia are shown in Fig. 1. On account of the wide separation of the fragments shown in the lateral view, I feared non-union, in spite of the patient's youth. Operation was planned but could not be done owing to a number of scar-

latina in the ward I found four weeks later that some union was apparent, and that there was only 0.5 centimetre shortening, while two months after the accident X-rays (Fig 2) showed callus bridging the large gap. The bones rounded off, and normal function was secured about four months after the injury (Fig 3) (Reported in *Amer Jour of Surg*, vol XLV, pp 114, 132, 1915)

CASE II—It was the memory of the result in Case I that authorized me to give a very favorable prognosis in the patient whose fracture is represented in Figure 4

The mother had fallen with the infant (three months of age) in her arms. When first seen (November 20, 1915), three days after the injury, there was tenderness and swelling of the already very fat thigh, but no crepitus nor abnormal mobility was noted. The baby was treated by flexing the hip and bandaging the thigh to the abdomen. The roentgenogram, a tracing of which is shown (Fig 4), was made sixteen days after injury. Union had occurred with right angle deformity. Six years later, in 1921, I secured the roentgenograms shown in Figure 5. Before the child was old enough to walk spontaneous correction of the deformity had occurred.

CASE III—A baby had its femur fractured during delivery (1923). A skillful surgeon applied a very neat little plaster-of-Paris dressing to the fractured limb and pelvis, but the accoucheur after seeing the roentgenogram (Fig 6), showing right angle deformity and overlapping, brought the baby to me for my opinion, fearing the deformity would result in disability. On my positive assurance that there was no cause for worry,

FIG 7a—Case III At age of three and one half months Antero-posterior view

the parents and their physician were satisfied, and three and one-half months later were pleased to see Figures 7a and 7b, showing that the growth of the limb had spontaneously straightened the femur.

Fractures near to, or involving, joints require accurate reduction almost in all cases, even in children, because even in the young malunion of a

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joint fracture very frequently causes restriction or loss of joint motion, and even if normal range of movement is preserved, distortion of the axis often is encountered (*varus* or *valgus* deformities in fractures at the elbow) (Figs 8 and 9) But sometimes, even in fractures near joints, nature will obviate by growth a deformity which the surgeon leaves uncorrected

CASE IV—H K, fourteen years of age, who was admitted to the Episcopal Hospital August 14, 1928, presented an impacted fracture of the right radius, above the wrist, with

marked angulation due to dorsal displacement of the lower fragment, he had also a greenstick fracture of the ulna at the same level (Figs 10a and 10b) The boy had also a

fracture of the calcaneum, which confined him to bed The forearm fracture was purposely left unreduced, being lightly dressed on a straight splint, in the confident expectation that spontaneous reduction would occur from normal growth of the bones Figure 11, from a roentgenogram made seven weeks after the injury, shows that this actually occurred, and Figure 12, from photographs I made five weeks after the injury, shows even at this early date very nearly normal function

CASE V—H S, eight years of age, came to my clinic at the Orthopaedic Hospital September 20, 1927, four weeks after a fall on the point of her elbow She brought with her X-ray pictures made at the time of the injury (Figs 13a and 13b), August 23, 1927, these showed a diacondylar fracture of the humerus by flexion, the condylar fragment being displaced forward into the bend of the elbow, but still in contact with the shaft fragment I advised no treatment, and asked the girl to return in a year At this time roentgenograms (Figs 14a and 14b) showed an entirely normal elbow-joint, and the clinical result was perfect, anatomically and functionally Had the lower

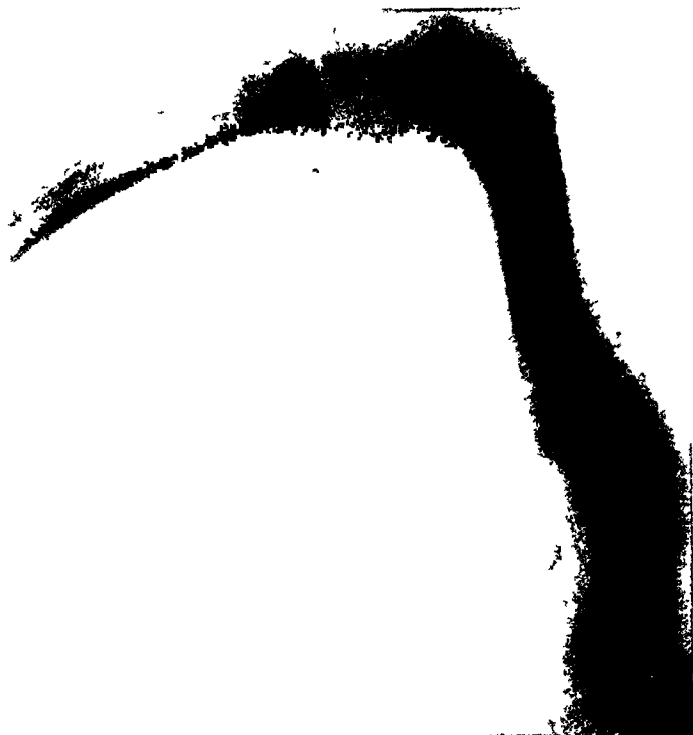


FIG 7b—Lateral view



FIG 8—Cubitus varus following use of anterior angular splint for supracondylar fracture of humerus

fragment been displaced backward in this child, as in the typical supracondylar fracture "by extension," it is not likely though possible, that full range of movement would have been secured without accurate reduction, if the condyles had been displaced laterally or medially, the child almost certainly would have recovered with a deformity of cubitus valgus or varus, as in Fig 9

In adults it is more important to secure accurate reduction than in children, because adults are unable to remodel their bones to compensate for



FIG 9—Cubitus varus following supracondylar fracture of humerus (a) Before operative reduction of malunion (b) After operation. Note the dots on the external and internal condyle and on the olecranon (This case was reported in ANNALS OF SURGERY, vol 151, 1912 p 647 Case III)

uncorrected deformities in the remarkable manner exemplified in the case histories of children which I have just quoted (Cases I, II, III, IV and V) But even in adults very little if any disability will result from lack of accurate reduction of a fracture in the shaft of a long bone, provided (1) bony union is secured, (2) the axes of the fragments are preserved, without angulation and without rotation of one frag-

ment on the other, and (3) the shortening does not exceed one centimetre

Distortion of the axes, or rotation of one fragment on the other usually entails disability at least to the extent of pain and soreness in damp weather or after arduous labor This discomfort is more often experienced in a neighboring joint than at the seat of fracture The latter, indeed, seldom gives rise to distress even if grossly deformed unless bony union is absent or unless the functions of the soft parts are involved The joint symptoms are due to disturbances in the weight-bearing axes, bringing strain on the ligaments, and provoking arthritic reactions in the form of exostoses and osteophytes These joint changes are most to be feared in the knee or the ankle, after fractures of the shaft of the tibia and fibula Both the knee and the ankle are hinge-joints accustomed to working in the same plane, and any rotation of one tibial fragment on the other at once throws these two important hinge-joints out of alignment In fractures of the femur and of the humerus, compensation for slight rotatory deformity may be brought about through the medium of the hip or of the shoulder-joint, by which means the proximal fragment can be rotated until the distal fragment is brought into the most useful plane Neither the ankle or the knee-joint possesses the function of rotation, and therefore no way exists of compensating for rotatory deformity in the tibia

IS ACCURATE REDUCTION OF A FRACTURE NECESSARY?



Fig. 10a—Case IV Henry Kuert four
teen years. Fracture of radius and ulna just
above wrist, with marked displacement of
radial fragments, which were purposely left
unreduced.

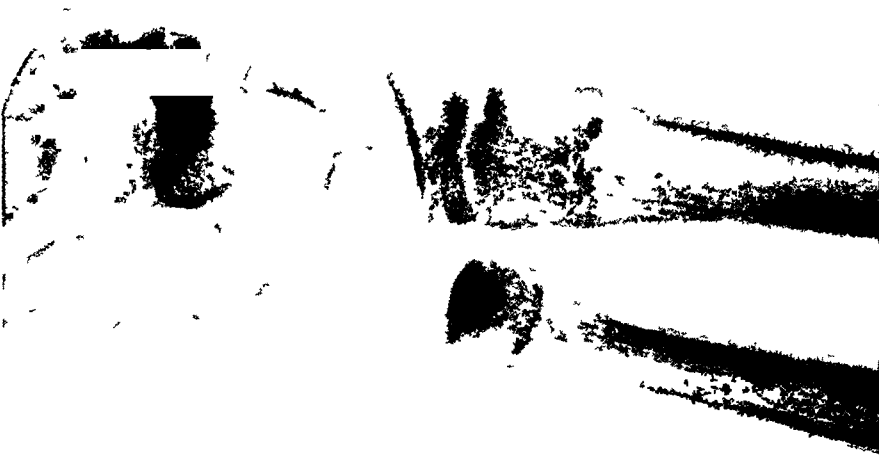


Fig. 10b—Anteroposterior view of lesion
shown in Fig. 10a



Fig. 11a—Case IV From A. R. V. seven
weeks after injury showing spontaneous re-
duction of deformity



FIG. 13a—Case V. Helen Smiler, eight years. Skieragraph made August 23, 1927, of recent third-degree fracture of left humerus with forward displacement of lower fragment, but without medial or lateral displacement. Anteroposterior view.

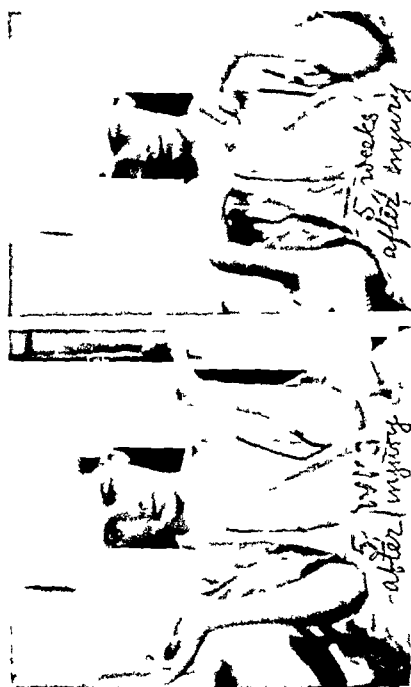


FIG. 12—Case IV. Photographs made five weeks after injury showing, even at this early date, very nearly normal function. Was accurate reduction necessary?



FIG. 11b—Anteroposterior view of wrist shown in FIG. 11a

IS ACCURATE REDUCTION OF A FRACTURE NECESSARY?

Much more harm than good often is done by insistence on securing accurate reduction of a shaft fracture in an adult

CASE VI—*Accurate Reduction of a Fracture of Shaft of Femur, Stiff Knee*
Out of work eighteen months
 F. C., twenty-four years of age, came to my clinic at the Orthopaedic Hospital October 9, 1928, complaining of immobility of his right knee. The shaft of his right femur had been fractured September 7, 1927, he also sustained a fracture of the skull and a fracture of the right ulna. Because of failure to secure accurate reduction of the fracture of the femur, open reduction, with fixation of the fragments by wire, had been done October 26, 1927, seven



FIG 13b—Case V. Lateral view. First seen three weeks after injury. No treatment advised.



FIG 14a—Case V. One year later showing spontaneous correction of deformity. Perfect function was present.

weeks after the injury. The operation had been done through a mid-line anterior incision, splitting the quadriceps muscle and the quadriceps bursa, and in order to secure end-to-end apposition, the bone ends were resected. The anatomical reduction was accurate (Fig 15), but the bone had been shortened by two centimetres and union was slow in developing, some infection of the wound having occurred. He spent ten months in the hospital where his recent injury was treated, being discharged with a brace on the limb, and walking with a cane. Three months later, when he first came under my care, he had only twenty degrees of motion in the knee-joint (160° to 180°), and marked atrophy of the thigh muscles. The limitation of movement evidently was due to adhesions between the quadriceps and the underlying bone (not an unusual occurrence when an anterior mid-line incision is used). This patient spent four months in the Orthopaedic Hospital, where (October 18, 1928) I loosened the quadriceps from the femur through a lateral incision, removing the wire from the femur, and implanting between the bone and the muscle a large free transplant of fascia lata. The knee was dressed in acute flexion, in plaster-of-Paris, when the gypsum dressing was removed, the knee was brought gradually into extension up to 150° , the

final 30° (150° to 180°) being secured by forcible extension under an anæsthetic (January 2, 1929) The range of motion finally secured after four months of effort was 90° How much better it would have been not to have sacrificed nearly eighteen months of this young man's life, in the pursuit of "accurate reduction"

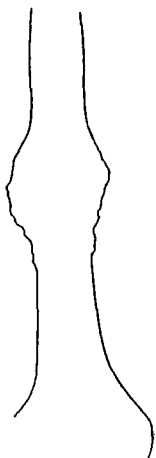
CASE VII — *Inaccurate Reduction of a Fracture of the Shaft of the Femur, Good Junction Out of work five and one-half months* W. K., sixty years of age, was admitted to my care in the Episcopal Hospital September 8, 1928, having just fractured his right femur at the junction of the middle and lower thirds. Shortening measured three centimetres. Buck's extension apparatus was applied at once, with a sliding leg splint to overcome friction, and coaptation splints of binder's board to the thigh. Fifty



FIG 14b—Lateral view of bones shown in Fig. 14a

pounds (23 kg) of weight were employed the foot of the bed being raised and counter-traction being made by a folded sheet passed around the perineum and fastened to the head of the bed. Measurements three days later showed lengthening on the injured side of 15 centimetres. The weights were gradually removed, until on September 20, twelve days after injury, only twenty pounds (9 kg) remained. From September 28 to October 2, 1928, the patient passed through an attack of acute cholecystitis, making a satisfactory recovery without operation. On October 11, less than five weeks after injury, the callus was palpable, and union was firm. Shortening measured not more than 0.5 centimetre. October 20, six weeks since injury, all weights and dressings were removed, the patient voluntarily raised his entire injured limb from the bed, and waved it around in triumph. October 27, seven weeks after injury, the old man was discharged, walking with crutches, and with active movement of the knee from 150° to 180° .

FIG 15a—Case VI. Frank Conrad, twenty-four years. One year after fracture of shaft of femur. Open reduction had been done seven weeks after injury, requiring resection of bone ends. Result: accurate reduction, two centimetres shortening stiff knee. Out of work eighteen months.



February 10, 1929, I visited the patient at his home. He discarded his crutches soon after leaving the hospital, and secured right angle flexion of his knee ten weeks after injury. When visited, his knee could be flexed to 70° or 60° , he walked spryly, without any limp, and complained only of some soreness in both knees in damp weather.

He resumed his work, which involves standing

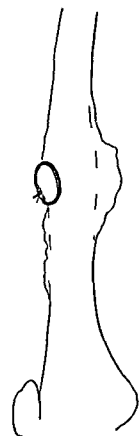


FIG 15b—Lateral view in Case VI

IS ACCURATE REDUCTION OF A FRACTURE NECESSARY?

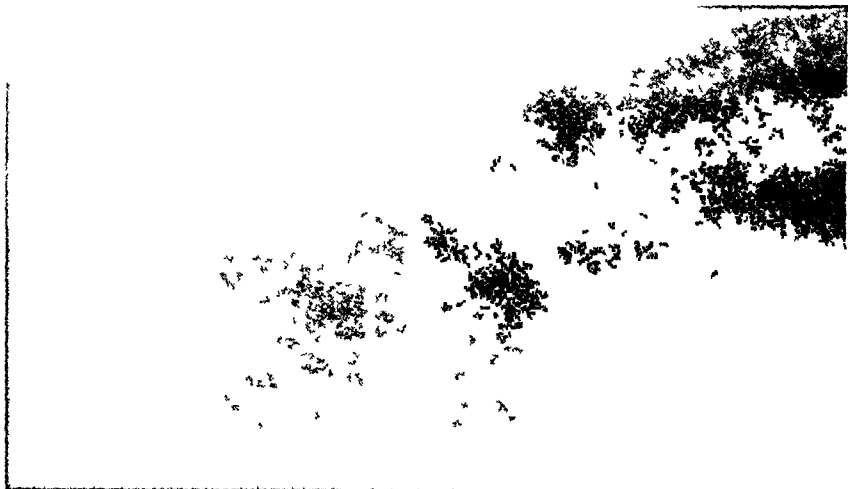


Fig. 16—Case VII William Kohler, sixty years. Fracture of shaft of femur on admission, September 9, 1928

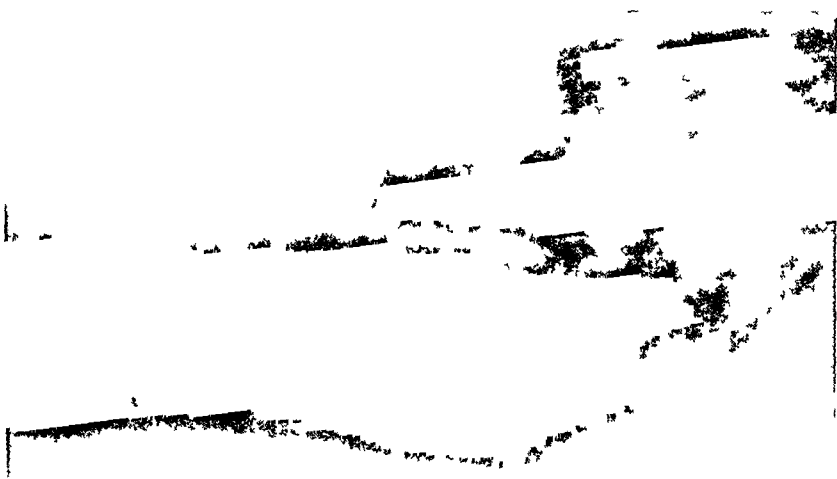


Fig. 17a—Case VII Six weeks after injury Union firm Walking with crutches seven weeks after injury

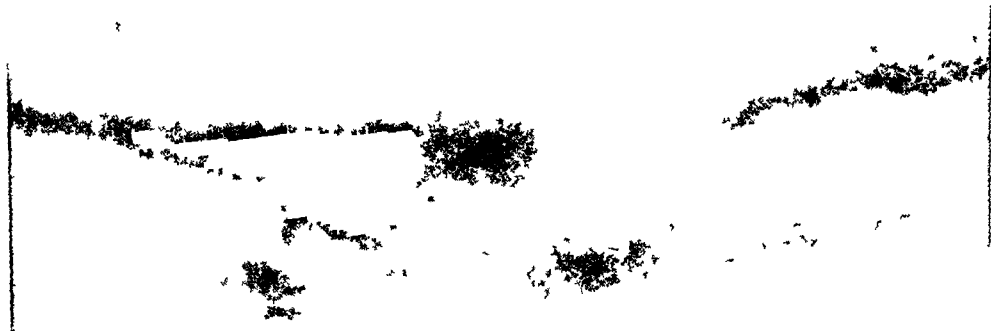


Fig. 17b—Case VII Out of work five and one half months Was accurate reduction necessary



Fig. 19b—Lateral view, showing wide separation of fragments, and rendering occurrence of union very doubtful. Note X opposite end of upper fragment (See Figs 18 and 20)

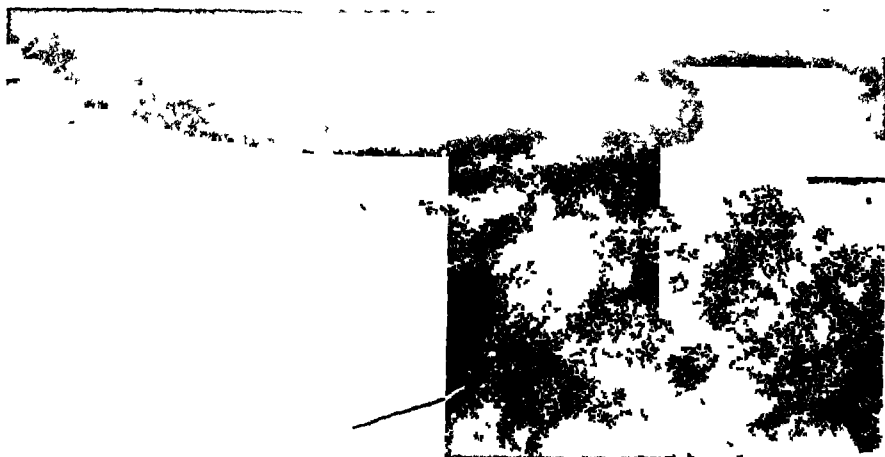


Fig. 19a—Mary Kelly, forty nine years, after attempted reduction, under anaesthesia. Anteroposterior view good alignment

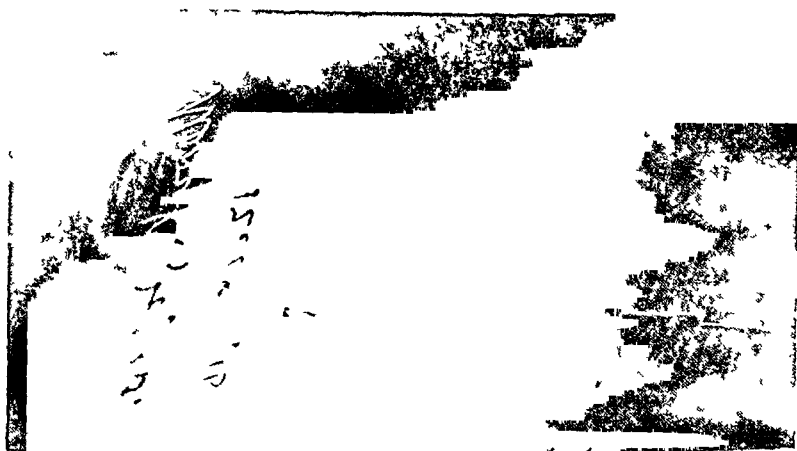


Fig. 18—Mary Kelly, forty nine years. Spiral fracture of shaft of humerus, on admission (December 28, 1916) showing transposition of fragments. Reduction indicated (See Figs 19 and 20)



Fig. 20—Mary Kelly, forty nine years. After open reduction and fixation by Parham bands. Perfect function. Out of work ten weeks.



Fig. 21a—Fracture of surgical neck of humerus on admission

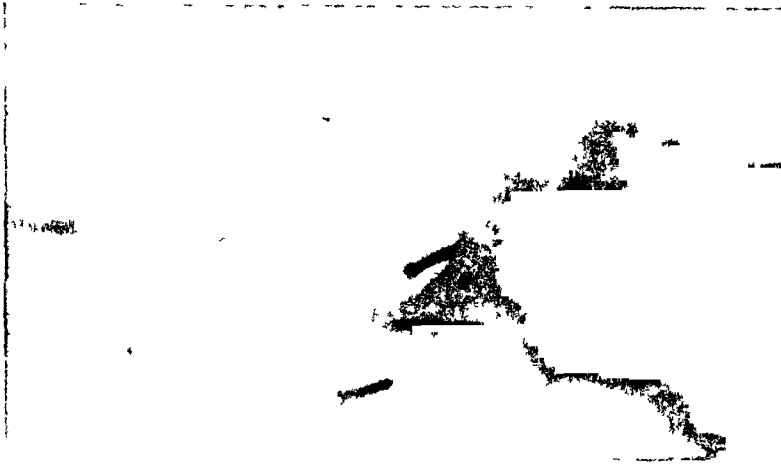


FIG 22b—Anteroposterior view showing
cutitus virus (Sec 118 23 and 24)
(The nails shown are in the wooden splint)



FIG 22a—Joseph Kennedy twenty two
years. Commenced fracture of lower third
of humerus on admission August 14 1915
Inaccurate reduction might impair function
of elbow joint Lateral view on anterior
angular splint

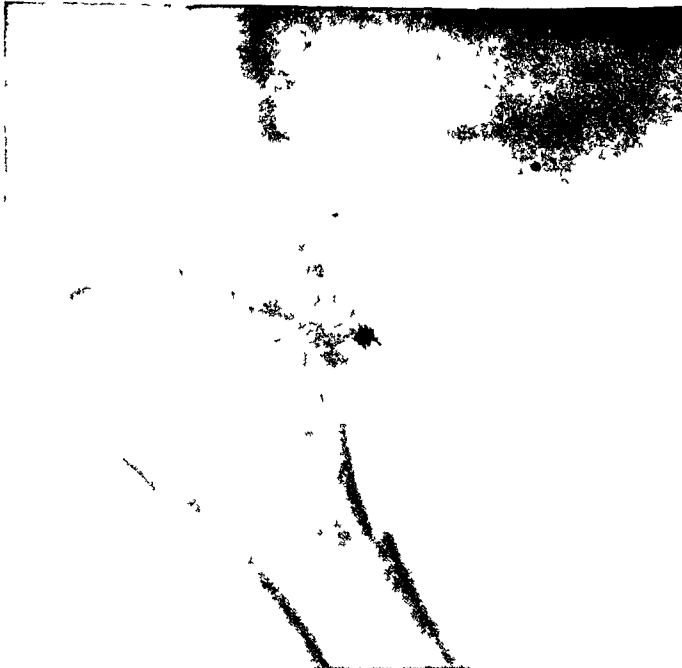


FIG 21b—After being dressed in abduction in bed

IS ACCURATE REDUCTION OF A FRACTURE NECESSARY?

eight or nine hours daily in a mill, less than six months after injury

Figure 16 shows the bone at the time of admission, and Figure 17 the appearance seven weeks later when he was discharged† Was accurate reduction necessary?

But when the fragments in a shaft fracture are *transposed*, so as to make the certainty of union doubtful, earnest efforts should be made to secure reduction (Figs 18, 19, and 20)

Joint fractures in adults, as a rule, require accurate reduction for preservation of function. Yet there are exceptions even to this rule. The mobility of the scapula on the trunk may very largely compensate for limitation of motion in the shoulder-joint following inaccurate reduction of a fracture of the surgical neck of the humerus, but it is certainly better to spare no effort, within reason, to secure

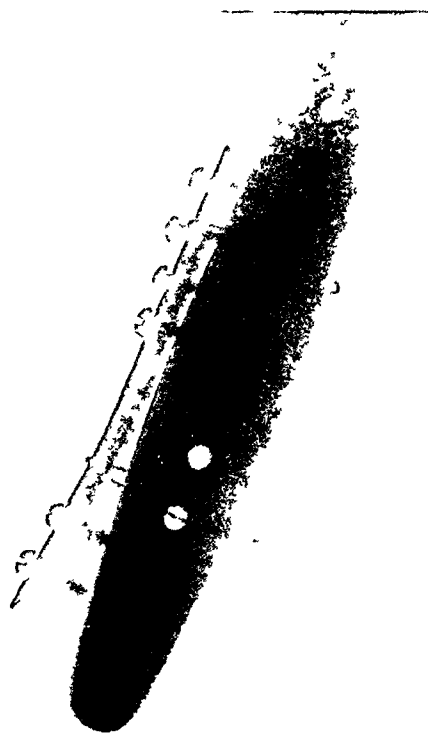


FIG 23—Joseph Kennedy, two months after open reduction and fixation by Lambotte plates and encircling wires (See Figs 22 and 24)

accurate reduction of a fracture of the surgical neck of the humerus rather than trust to the uncertain results which follow inaccurate reduction (Fig 21)

Disabilities following fractures about the elbow-joint, in adult life, are serious and lasting (Figs 22, 23 and 24) Worthy of note in this connection are fractures of the head or neck of the radius, as well as fractures of the external condyle of the humerus, which latter too often result in non-union (from lack of accurate reduction and sufficiently pro-

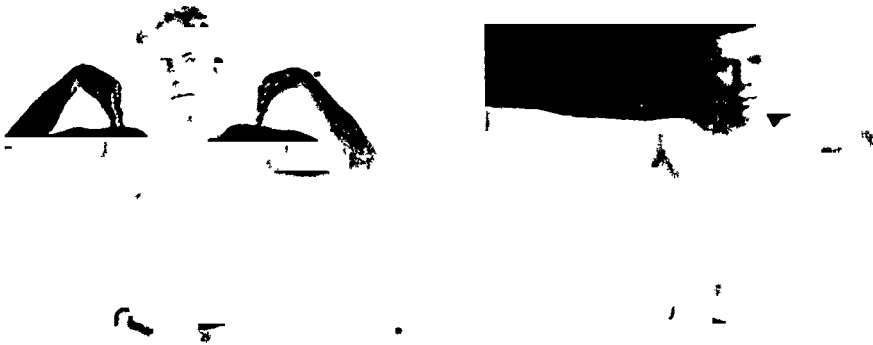


FIG 24a—Joseph Kennedy Three weeks after operation, in plaster of Paris dressing

† The femur, in the opinion of Doctor Bromer, shows roentgenologic evidence of an early stage of Paget's disease

longed immobilization), to be later complicated by ulnar palsy due to the gradually developing cubitus valgus

Fractures of the lower end of the radius frequently cause lasting disability if left unreduced. It is true that a great many patients secure perfect function without complete reduction of the deformity. My father was one of those surgeons who held (and I believe rightly) that function is more important than form, and when he himself had the misfortune to fracture his left radius above the wrist (about 1885) he sent for Dr Charles B Nancrede to attend him. Doctor Nancrede told me in after years that when he arrived he found my father sitting on the lounge in his office, and was greeted with the admonition that he needn't try to reduce the deformity, that the patient himself would apply the compresses, and all that Doctor Nancrede would need to do would be to bandage a Bond splint in place over these



FIGS. 24b and c—Eight months after operation showing restoration of function. Plates and screw still in place fourteen years after operation.

compresses. Doctor Nancrede was criticised by another Fellow at a later meeting of this Association (*Trans Amer Surg Assoc*, vol x pp 69, 75, 1892,) for having allowed his patient to recover with deformity, but he was able to retort that my father had operated for cleft palate just six weeks after he fractured his radius, and I can myself testify that he very soon resumed piano-playing with his accustomed brilliance and that he never had the least disability from the slight deformity which remained. There is still with us another Fellow who has carried since early youth a very conspicuous "silver-fork" deformity in each wrist, but who has pursued without disability for many years an extremely active career as operating surgeon. But these exceptions do not, I believe, impugn the general rule that in adults, even more than in children, accurate reduction is desirable in fractures near joints.

It is perhaps unnecessary that I should dwell further on this point, or that I should allude specifically to the importance of accurate reduction in cases of intra-capsular fracture of the neck of the femur, and in fractures about the ankle. Without accurate reduction of subcapital fractures of the neck of the femur, union will not be secured, and without accurate reduc-

tion of fractures involving the functions of the ankle-joint, lasting disability, from foot strain, will ensue. Fractures about the knee, also, may give persistent disability if imperfectly reduced, but I must confess that often I have been surprised to learn how little disability may follow a fracture of one or other condyle of the femur, or a supracondylar fracture of the femur, or a fracture of the tibia into the knee-joint, in which reduction has not been anatomically perfect.

It seems to me, then, that the whole matter may be summed up somewhat as follows:

A In fractures of the shafts of the long bones, it is sufficient to secure (1) bony union, (2) without axial distortion, and (3) without appreciable shortening. The limits are much wider in children than in adults, and in adults the limits are wider in the humerus and femur, than in the forearm or in the leg bones. But repeated attempts at reduction may give poorer results than leaving the fragments inaccurately reduced.

B In joint fractures no reasonable effort should be spared to secure anatomical reposition. Even in children joint fractures, if unreduced, may cause lasting disability from axial distortion or limitation of joint movement. The exceptions to this rule are not numerous enough to break it.

C In all cases the condition of the soft parts is too often overlooked, and proper treatment neglected. The aim of treatment in any case of fracture is restoration of perfect function, and this is only in part dependent upon the form of the bone.

NON-UNION AFTER FRACTURE

By KILLOGG SPIED M.D.

OF CHICAGO, ILL.

As RONTGENOLOGIC study advances and enables us to penetrate more and more into clinical union after fracture, the more difficult it becomes to separate the instances of delayed union from non-union. Delayed union clinically despaired of, illy treated, used, not immobilized probably leads to absorption of the slight effort made at the fracture site and final non-union. One can no longer say that non-union may exist solely when there is no attempt at repair. Just as true a non-union may be found in the pathology exposed at an operation when there is considerable bulbous callus as when the bone ends are buried in muscle or soft tissues and give no evidence whatsoever of callus. A more specific nomenclature for or clinicopathologic division into types of non-union must be devised.

Clear cut rounded fragment ends, those usually associated with pseudarthrosis, are an end stage. Callus may have been present at some stage of the healing attempt, certainly some newly-formed fibrous tissue was, but no calcium salts were deposited in this tissue to cause ossification or calcification as we understand bone healing. The process might be compared to keloid scar formation which lacks contractile power or cutting off of blood supply to form a normal white scar. Instead the keloid remains as more or less young connective tissue red oedematous possibly easily engorged with blood. Callus may likewise linger in the formative stage pending a proper deposition of calcium salts and a final era of calcification or ossification.

As far as we know the process of repair after fracture consists in

1. Hæmorrhage which may extend into surrounding muscle, fascia or skin
2. An organization of this blood clot by an ingrowth of connective tissue around newly-formed blood vessels
3. Calcium and phosphorus salts are deposited in this connective tissue stroma in the perivascular areas
4. The blood vessels contract or disappear the newly-formed calcified tissue assumes trabecular arrangement in the physiological axis of the bone, leading to the formation of new bone

5. Bony trabeculæ responding to the calls of judicious use form in the lines of the original bone and a new supporting scaffold of bone results.

Among other theories as to the cause of non-union it is believed that there is a change in the hydrogen ion concentration of the blood serum in the vicinity of the fracture which changes the local reaction of the blood serum and apparently has to do with the precipitation of calcium salts. An attempt to determine this point experimentally has been made but so far the difficulties obstructing the collection of unbuffered blood from the fracture site have not been overcome. It is supposed that these calcium salts may come

from two sources—from the circulating blood and from the ends of the fractured bones which undergo demineralization and atrophy

In a study of the prevention of non-union it seems logical that repeated or numerous attempts at reduction of a fracture interfere with this process of bone union. The tissue destruction and vascular disturbance following repeated rough movements probably lead to the formation of products which change the local chemical reaction in the tissues and interfere with the normal deposition of calcium salts. Likewise the vascular outgrowth is disrupted, disheartened and ended—the fibrous tissue cicatrizes and there is no chance for the laying down of calcium salts in a normal manner. Fibrous union results.

It seems that incontrovertible evidence is offered of the local cause of non-union when non-union occurs in one bone after fracture of both bones of the leg. The fibula usually heals bony, the tibia fails to unite. However, the study of the blood calcium and phosphorus content based on non-union following osteotomy for bow legs in rickets has attracted much attention and has always seemed possibly to offer an explanation of non-union. In 1924 Petersen (H. A. Petersen, *Bull Johns Hopkins Hosp*, vol xxxv, p 378, November, 1924) claimed that there existed a definite relationship between the concentration of the inorganic bone-forming elements in the blood serum and the healing of fractures. So closely allied was this relationship considered that it was stated that if the product of the phosphorus and calcium content of the blood serum (milligrams in 100 cubic centimetres) was less than thirty, a fracture would not unite. If the phosphorus calcium product was raised above this figure to a normal level by increased diet, fractured bones would unite. Petersen believed that a constitutional disturbance was present in most patients with non-union after fracture, that the amount of phosphorus in the blood serum was particularly low and that the calcium phosphorus product of these two taken in milligrams per 100 cubic centimetres of blood serum had to be not lower than thirty-five to forty to produce bony union. If the product was equal to thirty or lower bony union would not follow after fracture.

Seventeen cases of ununited fracture in human beings were reported by Petersen. Eleven of these patients showed deficiencies in either the calcium or the phosphorus content of the serum, giving low calcium phosphorus products. Petersen took as a mean the Tisdall and Harris (F. F. Tisdall and R. T. Harris, *Calcium and Phosphorus Metabolism in Patients with Fractures*, *J A M A*, vol lxxix, pp 884–885, 1923), findings of adult's calcium of ten milligrams per 100 cubic centimetres and phosphorus 3.8 per 100 cubic centimetres in the study of calcium and phosphorus in normal healing fractures. In six of Petersen's patients who had non-union the blood findings were normal on this basis. It is the writer's opinion that blood serum calcium and phosphorus vary seasonally, geographically, individually, and with the time after fracture that the blood is drawn. It is also found that the estimations must be made promptly with fresh blood.

Bay (L. Bay, Calcium Content of the Blood during Callus Formation, *Gior d Bacteriol and Immunol*, vol 11 pp 94-100, February, 1927) studied the calcium content of the blood in normal individuals and also in those with fractures. In normal young patients the average calcium content of the blood was 9.3 milligrams and in normal adults 7.85 per cent. He found that the calcium content immediately after fracture rose varying on an average from 8.4 milligrams to 10.2 milligrams reaching its maximum on the eighteenth to the twenty-second day after fracture, then decreasing gradually to normal. The fall to normal average was always delayed, however until the fractures were clinically healed.

The effect of metabolic products and albuminous bodies on the deposition of calcium salts in osteoid and callus forming tissue was investigated jointly by Schwarz, Eden and Hermann (R. Schwarz, R. Eden, and Hermann, *Chemical Processes in the Healing of Fractures*, *Biochemische Zeitschrift*, vol cxlv pp 100-198, 1924), who found that the calcium content of the healthy human bone and bone from other mammals is about 24 per cent, the phosphorus content about 11 per cent. The atomic ratio of the two elements corresponds therefore to approximately 1 calcium to 0.6 phosphorus. After analysis of the callus they found that the calcium content was 16 per cent and the phosphorus 2.4 per cent to 5.4 per cent giving an atomic proportion of calcium to phosphorus of 1 to 0.2 or 1 to 0.4 at the highest. They concluded from these figures that the primary process of ossification consists of a deposition of calcium upon an organic substance which is followed by a secondary reaction of binding of the phosphoric acid until an atomic proportion of 1 calcium to 0.6 phosphorus is reached at which point the callus becomes bone.

I have repeated Petersen's work on dogs, inducing a reduction of blood phosphorus by dietary methods and subsequently fracturing the legs of these dogs to study the rate of union compared to a normal control dog obtained if possible from the same litter. The rate of union was studied clinically and roentgenologically, and the work was further amplified by making an histologic examination of three- and six-week specimens after fracture in both reduced and control dogs. From study of these animals, a more detailed report of which will be made elsewhere, the conclusion seems logical that the peripheral blood calcium phosphorus product has little if anything to do with the proper healing of the bones of dogs under strict experimental and dietary control.

In the fracture ward at the Cook County Hospital, the senior fracture resident, Doctor Conley, working with me has performed many blood calcium phosphorus determinations on fracture patients. Routine work of this character was carried out on over 200 patients in all seasons of the year, irrespective of age, type or fracture, and bone or bones involved, previous or subsequent (hospital and home) diet, or the time of day blood was withdrawn. Omitting any detailed description of this work it may be said that immediately—meaning within one hour, as blood was usually drawn for the

first determination before the patient was undressed and his fracture considered—after fracture the phosphorus blood content is low as far as can be told, not knowing what the mean for the individual was before his admission on account of fracture. The calcium content seems to vary but little from what is supposed to be normal blood calcium content for all individuals. The phosphorus content, after fracture, quickly rises, remains elevated—in some instances as high as 5.5 milligrams for three or four days, then gradually falls, depending largely on the length of disability as far as can be determined. Diet has no effect on either the calcium or phosphorus content found in the peripheral blood at this time. Any operative procedure on the human body leads to an immediate rise in blood phosphorus followed by a fall to normal within a few days.

If fracture patients are followed through for a long enough time after showing a relatively low calcium phosphorus product, no matter what diet is used, or whether calcium is administered by mouth or not, there is ultimately a rise of this product to normal. The depression is usually transient and is probably due to muscular inactivity.

The blood phosphorus calcium content was carefully tabulated for ten patients who had non-union after fracture. Some of these patients were under observation over two years. Many samples of blood were examined and most of the patients were operated upon, some successfully, others not. Likewise from a large series of normally healing or average fracture patients whose blood had been studied, ten patients of different ages, types of fracture, and bone involved were chosen to match against the summary obtained in the instances of non-union, using many blood samples over a long period of time. These blood findings were

Ten patients with non-union after fracture, average blood findings

Calcium	10.64 milligrams per 100 cubic centimetres blood serum
Phosphorus	3.53 milligrams per 100 cubic centimetres blood serum
Product of the two	38.19

Ten patients with normally healing fractures gave average blood findings

Calcium	10.16 milligrams per 100 cubic centimetres blood serum
Phosphorus	3.87 milligrams per 100 cubic centimetres blood serum
Product of the two	39.26

After the experimental work on dogs and an extensive clinical experience and investigation it appears that the blood content of calcium and phosphorus has little to do with the healing of a fracture or the prognosis of non-union after fracture.

Other lines of investigation have attracted men to seek cause of non-union. Recently Oppel, of Leningrad, said it was possible to raise the blood calcium level of an individual by the insertion of a bone graft in the body. Leriche (*Les Problemes de la Physiologie normale et pathologique de l'Os*) thought that a bone transplant raised the local calcium content and was an aid to bony union. If that were so and a high calcium blood content

had to do with the certainty of healing of fracture, that method of treatment would be an all powerful argument in favor of using an autogenous bone transplant in all patients operated upon for non-union after fracture. This idea has been at least partially exploded by the work of Halperin and Walsh (*Archives of Surgery*, vol. *xviii*, p. 819, March, 1929), who found in their conclusions in investigating a method of supplying calcium to patient with tetany after thyroidectomy which had involved the parathyroid, that homogenous bone transplants in normal dogs and rabbits failed to raise the blood calcium level. The removal of thyroid and parathyroids may involve other factors in addition to those which have to do with the blood calcium content. These other factors may help induce non-union.

Fontaine reported eight cases of delayed union and pseudo-arthritis which were successfully treated by periarterial sympathectomy. Their attempt was based on the work of Uffreduzzi and Palma who believed that the healing of a bone took place more rapidly than normal in a limb in which periarterial sympathectomy had been performed. Their eight patients had been treated by both closed and open methods without bony union developing. They claim that in all these cases, even following failure of bone grafts, the performance of periarterial sympathectomy on the affected limb resulted in rapid consolidation of the fracture.

The effect of parathyroidectomy leading to loss of blood calcium may have been expected to bear upon non-union after fracture by producing an alkalosis. Ross' conclusions were that the removal of two parathyroid glands from dogs does not delay healing of fractures, whereas removal of three delays bony union for four or five weeks. The blood calcium level is not diminished by excision of two parathyroids but when three are excised it drops from two to three milligrams per 100 cubic centimetres and returns to normal as union occurs. (*Relation of the Parathyroids to the Healing of a Fracture as Controlled by the Rontgen-rays*, *Archives of Surgery*, vol. *xvi*, No. 4, p. 922, April, 1928.) Wells believes that the reason bone is so rarely deposited in veins is that the excess of carbon dioxide, with increased acidity in the venous blood, keeps the calcium in solution. If an alkalosis were present as after pyloric obstruction with vomiting, or after parathyroidectomy, one might obtain local alkalosis and a deposit of blood calcium to heal a fracture. This physiologic theory would not seem to fit into the practical application of the Thomas damming and hammer method where local hyperemia is induced, followed by pounding. The pounding, however, by inducing local change in the tissues, breaking them down and causing acid formation, may lead to a further increase of calcium salts in the surcharged venous blood in the area. The venous blood would hold much calcium, the hammering would cause acid formation and lead to an increase of calcium salts which might cure the non-union, when local precipitation could be secured.

Mild infections occurring after operations upon non-union of fracture may have a similar influence. Clinically, several such instances have been met and it has been felt that the infections lead to an early exuberant callus formation. The local chemical change in the reaction of the tissues may explain this.

This clinical report on non-union after fracture is based on a study of seventy-four patients, seen in the last eight years, most of whom were operated upon, so that material for pathologic and microscopic study was available. There have been no deaths in this series. Three attempts to obtain union have led to failures from infection, one leading to a thigh amputation, one to a leg amputation and the other after a second operative attempt to an amputation of the forearm. In one instance a man suffering from non-union of both humerus and tibia responded by a good bony union in the

NON-UNION AFTER FRACTURE

humerus after operation which involved the use of an intramedullary bone splint, but had a tedious convalescence from non-union of the tibia at a second operation in which no bone transplant was placed

The probability that local cause leads to non-union seems incontrovertible To prevent non-union the following suggestions are offered:

Make reduction after fracture as soon and as complete as possible, control by X-ray examination

Try to eliminate infolded soft parts between fragments by palpation at the time of reduction, the feel of bony surface rubbing on itself is gratifying

If manipulation and splinting or skin traction fail to give satisfactory reduction, do not hesitate to employ skeletal traction or open operation *early*

Adopt a sufficiently long period of efficient immobilization for the individual, the bone and the type of fracture concerned.

Do not yield to surgical impatience and adopt methods of treatment which may lead to disaster instead of help.

Do not permit too early or injudicious weight bearing before the bone has hardened or been thoroughly reconstructed

Treat the fracture, not an X-ray film

The treatment of an accepted instance of non-union after fracture may be non-operative or operative Non-operative treatment is usually prolonged and may be uncertain in its results, however, it may be the wisest course to pursue on account of the patient's general condition, his mentality or because of medicolegal complications Also the situation, training, and surroundings of the surgeon himself are of considerable importance Non-operative treatment contemplates first an effort to put the fracture back into the line of original treatment which generally means a plaster-of-Paris dressing This may bring finally a happy result especially if in the original treatment too early weight bearing or use or improper attempts at immobilization have been used An efficient plaster dressing or a proper splint may lead to bony union, save the risk, time, and expense of operation with its necessary hospitalization

Local irritation at the fracture site is also valuable This may be obtained by guarded use of the part in some sort of splint or support so that irritation may be developed locally in the long axis of the bone, not in the lateral axis which might cause increasing angulation and deformity from contra-axial strain In leg fractures ambulatory splints and Delbet's splints are helpful

Massage and local hyperemia are also often required Dry and moist heat may be used, electric heat has become very popular but is far from being a cure-all Along with this method of treatment may be put Bier's hyperemia and the Thomas damming and hammer method. Light application by means of a Quartz light up to fifteen minutes daily has some effect on the patient as a whole, and the exposure to light need not involve the fracture field directly If the patient is septic or marasmic Quartz light is certainly of value. Cod-liver oil, high protein diet, vegetables, milk or buttermilk and phos-

phorus in 1/100 grain doses or even irradiated ergosterol should be used as general tonics and in an effort to supply the blood with all its usual requirements of bone-forming material

An hypodermic or intra-osseous injection of irritants at the site of non-union is still used as a non-operative method to bring about a cure. Such materials as the patient's own blood, tincture of iodine, bone-marrow extracts, phosphates and emulsion in oil of dried bone are employed. These may promote local bone-forming reaction and lead to union but must all be accompanied by proper periods of immobilization, and supervised splinting.

If these non-operative methods fail and operation is resorted to, the whole scheme of treatment should be reduced to the simplest terms. The equation required to get bony union in physiologic simplicity requires freshened bone ends, recent blood clot and a *reasonable* approximation and fixation of the main fragments. Too rigid, too extensive or exaggerated methods of internal splints are not often required.

Minor operative procedures may bring about bony union. The most useful is cross drilling through the stubborn fragment ends. This can be done through a small incision with local anæsthesia. Multiple cross drill paths are made from one fragment to the other across the area of non-union. Fresh blood is thus carried into and across the field of non-union. New paths through the old callus or fibrous tissue are opened, along which calcification may develop and serviceable union may follow.

Major operations carry certain prerequisites common to all procedures which involve the opening of bony surfaces. A well-planned operation with a careful asepsis is necessary. All interlying fibrous tissue between the major bone fragments must be removed to expose fresh, bleeding, bone surface, to open in some instances the bony plugged medullary canal of long bone. This exposure must be followed by a coaptation of these bone surfaces if possible. Rarely the loss of bone substance must be bridged by an autogenous bone transplant.

If the skin or soft part surface over the non-union is scarred or recently inflamed, one must wait for all inflammatory evidence to subside or must remove scar tissue and substitute in its place pedicled or transplanted fresh skin flaps. In doubtful instances where later infection is even remotely suspected, and infection may lie dormant in scars for years, heavy massage and use of the part may light up the bacterial growth and cause a recurrence of infection. It is better to do this before operation than to have the operative trauma cause the disaster.

The satisfactory types of operative procedure are

Simple replacement of the prepared bone surfaces followed by coaptation, by step operations or the use of light absorbable sutures, such as catgut. Kangaroo tendon is too difficult to absorb and may lead to infection. A companion bone as in leg or forearm may have to be shortened to permit coaptation. No attempt is made to do any definite internal fixation of the bone,

NON-UNION AFTER FRACTURE

except by interlocking of fragments by position. Immobilization is furnished by a proper external splint after the wound is closed.

Internal splint fixation is also a proper method. For this purpose the bone surfaces are prepared as required in all operations for non-union. The internal splint may be metal, ivory, or bone. It is by far the best to use the patient's own bone. The method of application of the graft may be (a) Intramedullary graft, (b) sliding, inlay or onlay graft, (c) osteoperiosteal grafts and bone hash.

In spite of criticism and claims of some surgeons that intramedullary bone grafts are not physiologic they possess certain advantages. They are easily and quickly inserted, they give a certain amount of internal fixation. They should be quite long and should not plug tightly the intramedullary canal. They seldom lead to infection or post-operative complication except perhaps some delay in the full development of endosteal callus which must wait on their absorption.

Sliding, inlay or onlay grafts should be generous in size or really massive. The graft should be cut at least three times as long as the length of the loss of bone substance to be bridged on the poor quality bone with which it will be in contact. If the graft is cut slightly longer than the trough in which it is to lie it can be wedged in by undercutting the cortex at each end of the trough so that it holds firmly, requiring no other fixation. The simplest possible means of fixation should be employed. Heavy sutures of Kangaroo tendon are not required, bone peg screws of autogenous bone are excellent but require a prolonged time of operation and much handling of tissue. Wedging the graft into a carefully measured and cut channel for its reception is enough fixation. In cutting the transplant it is best to use a clean saw different from the one used to open the trough.

Osteoperiosteal grafts and bone hash, made from finely cut up pieces of sterile bone fragments, can be packed in or around approximated bone ends or be used as an adjuvant to other grafts of bone. In the fear of chance of failure, when bony union has been long delayed and other factors are against success, their use is possibly to be encouraged. Bone hash often fills in an hiatus left after freshening bone ends and saves the necessity for resection and shortening of a companion bone as fibula or ulna.

All open operations for non-union after fracture require careful, solid, prolonged external splinting. Plaster-of-Paris is the very best material to use. The splint must be extensive and solidly built to withstand prolonged use because after such an open operation the period of immobilization of the parts is to be from two to four times as long as that required for immobilization after the average fracture involving identical parts. Even slight too early motion after a well-planned and executed operative treatment for non-union may mitigate against a successful result.

The percentage of cures after carefully planned and executed operations for non-union constantly rises. Some operations fail probably because the bone has been ununited too long, its ends are too sclerosed, it must be cut

back too far to bring any fresh bony tissue into view. The intrinsic osteogenetic power of the bone may be lost, probably on account of prolonged atrophy from disuse or deficient blood supply. Naturally the longer the gap which the surgeon attempts to bridge in an old, ununited fracture, the greater the chance of failure.

Bone transplants and internal splints are really not required in every case, in fact I am omitting them altogether where it is possible to obtain any end-to-end contact between freshened fragments. They are necessary to bridge distance, to lend security after the replacement of fragments or, as in the radius, to prevent rotation and angulation of major fragments until union follows.

THE IMMEDIATE TREATMENT OF OPEN FRACTURES

WITH SPECIAL REFERENCE TO FRACTURES OF THE TIBIA
AND THE EVALUATION OF PLATING

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THERE IS scarcely any need to emphasize that treatment of open fractures must be immediate, any other belief has so long been incompatible with good surgical judgment and rational practice that it may be considered axiomatic and beyond controversy. But of what this immediate treatment should consist is properly a matter for detailed consideration.

The object of the treatment is to prevent infection of the open wound, and to obtain and maintain reduction of the fracture, this resolves itself into proper care of the skin about the wound, treatment of the wound, and reposition and maintenance of reposition of the fracture.

It should be emphasized that first-aid treatment must not only "splint them where they lie," but should control hæmorrhage by tourniquet, if simple pressure will not suffice[†]. The skin about the wound *may* be painted with iodine against further contamination, but the wound itself should simply be protected by a sterile dressing. Under no circumstances should manipulation of the fracture be attempted and above all, no bone protruding through the skin should be replaced until in the hands of the operating surgeon after proper antiseptic preparation and in safe aseptic surroundings.

In the receiving ward or admission room if hæmorrhage is found to be under control the general condition of the patient should receive first consideration. Shock should be combated by the usual methods of heat, administering of fluids, hypodermoclysis or intravenous saline and glucose, and transfusion, if loss of blood has been a factor. Morphine is especially valuable to minimize the pain or discomfort of adjusting splints, or of a gentle preliminary examination, stimulants are of doubtful value. Tetanus antitoxin, 1500 units, after an intradermal test for sensitization, is administered.

Examination of the fracture area may then be made. Simple inspection will suffice in the majority of cases but should be supplemented by tests for nerve injury. Splints may be readjusted or changed when indicated. Extensive circular crush with mangling of the soft tissues and laceration of the main blood vessels will be indications for primary amputation.

If, and when, the patient's general condition is satisfactory, a radiograph is taken[†] and he should be transported to the operating room for the care of the fracture and its wound. Only if the receiving ward is manned

* A tourniquet should be loosened every four hours if it is required for any length of time.

† A radiograph is highly desirable but no delay in immediate treatment to obtain it should be countenanced.

and equipped to afford teamwork and aseptic surroundings similar to an operating room is it justifiable to use it in the treatment of an open fracture. A general anæsthetic should be administered and the procedure should consist of (1) Treatment of the skin, (2) Treatment of the wound, (3) Treatment of the Fracture.

1 *Treatment of the Skin*—While cleansing of the skin is undertaken, the wound should be carefully protected by sterile gauze, and the part is shaved. Soap and water may be used but must be followed by copious application of alcohol and ether or benzine, if alcoholic antiseptics are to be used. With alcohol and ether or turpentine excellent cleansing is obtained, and shaving can be done after wetting the hair with alcohol. Personally, I prefer this method to soap and water. Iodine skin disinfection follows, or alcoholic solutions of picric acid 5 per cent or mercurochrome 2 per cent may be used.

The wound margins are then carefully sponged with hychlorite 1 to 6, or accurate Dakin's solution and the wound is draped. Any protruding bone is also thoroughly anointed with pure hychlorite or swabbed with Dakin's strength hychlorite. Dichloramin T 20 per cent has also been used.

2 *Treatment of the Wound*—If the wound is small and involves only the skin, it may be thoroughly cleansed with Dakin's solution and sutured and the fracture treated as a closed fracture. If the wound is small and there is evidence of muscle injury or deep soft tissue involvement the best surgical judgment will be needed to determine the proper treatment. These wounds may be caused either by a sharp spicule or fragment of bone lacerating the skin from within, or by a puncture of the skin from without. Obviously the wound from without promises the more serious consequences by direct implantation of skin clothing or soil bacteria. Often the history of the injury will cast the spotlight from which the source of the trauma may be decided. A small laceration caused by the fracture margins of which the penetration has been slight if any may be thoroughly cleansed, preferably with Hychlorite-Dakin's, and allowed to close or if oozing is free, a light packing of hychlorite gauze may be used and the fracture treated as a closed fracture. If an external object has made the wound, or if any doubt exists as to its etiology, or if there is any suspicion of deep contamination, no matter what the cause, the skin wound should be freely enlarged, the extent of the soft tissue injury carefully ascertained and the entire wound thoroughly and meticulously cleansed with Dakin's solution debrided if necessary and sutured tight or with a small rubber tissue drain.

With large and obviously contaminated wounds with extensive muscle involvement the cleansing and sponging out of any foreign material and debris must be complete and thorough. Hychlorite-Dakin's should be used and care taken to reach every crevice of the wound. Thorough debridement should follow, but not the extensive debridement of gunshot or shell wounds, usually the snipping away of non-viable muscle fragments is sufficient. After a further flooding of the wound with hychlorite it may be primarily sutured

IMMEDIATE TREATMENT OF OPEN FRACTURES

either tight or with a corner diam, or packed wide open with hychlorite gauze and Carrel's tubes inserted. The procedure must be taken at the best judgment of the operator. An extensive muscle wound with foreign material ground into it, where a satisfactory débridement has not or cannot be performed should be prepared for Carrell-Dakin treatment and not closed. Where soil infection of muscles is probable, open treatment is best. Sherman's⁷ practice, however, is to use Carrel-Dakinization as a routine for the majority of these extensive fractures. Swett⁸ has recently argued for closure of the wound whenever possible because of the likelihood of infection from frequent dressings of an open wound. He believes infections in open fractures have been fewer since routine closure without tight sutures has been used.

3 *Treatment of the Fracture*—The skin and wound having received adequate attention, reposition of the bony fragments should follow. If bone protrudes through the skin it requires careful cleansing before the wound is enlarged to permit reduction. If bone protrudes or is exposed in a large wound it should be cleansed as any other part of the wound. If the seat of fracture is away from the wound, after treatment of the wound the fracture may be treated as any closed fracture. When, however, the bone is exposed in the wound it should be reduced by manipulation under direct vision.

Maintenance of reduction will vary with the type of fracture and the individual operator. A transverse fracture in which there may be sufficient serration of the bone ends to hold the fragments together after reposition may be immobilized in moulded plaster splints or a plaster case. However, some form of traction and suspension lends itself best to the treatment of open fracture, especially in the femur and humerus and in spiral and comminuted fractures and those that require frequent dressings. In comminuted fractures, only the completely loose and free bits should be removed. Usually the fragments can be placed in alignment and notably in the femur and the tibia skeletal traction should be used to maintain the position.

The use of internal fixation in open fractures may still be considered debatable ground. In our clinic there has been no hesitation in plating fractures of the tibia and radius and ulna immediately if oblique or when comminution is slight and there seems little likelihood of proper apposition being maintained without fixation. In extensive comminution, however, suspension traction treatment is to be preferred.

A study of our last sixty consecutive open fractures showed a distribution as follows

Humerus	0	} Upper third, 6 Middle third, 17 Lower third, 15
Radius and ulna	14	
Femur	8	
Tibia and Fibula	38 (63 1/3 per cent)	

Two were admitted with infection. Six (10 per cent) developed infection—five quite mild, but one a gas gangrene from reduction of protruding bone before admission to the hospital. There were three deaths—two from

pulmonary embolism in the third week, and one in twenty-four hours from the shock of multiple fractures

The preponderance of fractures of the tibia and fibula is immediately striking ($63\frac{1}{4}$ per cent) This was noted also in a previous report from our clinic (Estes, Sr⁴), and has been remarked by Swett⁸—61.5 per cent in his series Having been informed by Dr L A Shoudy, of the Bethlehem Steel Company, that open fractures of the tibia were particularly a protracted problem in his follow-up dispensary treatment and realizing that it has been customary to plate many of these fractures, a detailed study has been undertaken to determine the relation of plating, if any, to end results

Fractures of the Tibia (38)

Delayed Union, 18 (47.4 per cent)	{ Upper third, 1
	{ Middle third, 12
	{ Lower third, 5

Twelve were plated

One had slight infection

Of these one had Wassermann ++ No active lues One had low calcium (90) and Phosphorus (25) Age was not a factor, none of the cases was over fifty years

Comminuted Fractures (14)

Normal Union	5 (4 plated)
Delayed Union	9 (7 plated)

Three plated immediately Delayed union in all

Bone fistulas, 3

Non-union, 0

Union is notoriously indolent in open fractures of the tibia and has been observed with all forms of treatment, even with skeletal traction, but if plating delays union it does not seem likely that plating *per se* but the increased trauma incident to the application of the plate may be the factor It must be remembered also that those fractures selected for plating are usually the most difficult to handle and those attended by more severe injury

Due to the kindness of Doctor Shoudy another group of industrial fractures with complete records has been personally examined to estimate the final results of plating

Fractures of Tibia, Industrial (31)

	No	Good Anatomical Position	Same Job	Non-union	Bone fistulas	Average time out of work
Plated	19	14 (73.7 per cent)	17 (90 per cent)	0	10	9½ months
Not plated	12	8 (66.6 per cent)	10 (83.3 per cent)	1	1	7 months
	31	22	27 (87 per cent)			

Though this is a comparatively small group of fractures it represents the worst and especially difficult cases, most of them being open comminuted fractures which had been treated in St Luke's Hospital previously It will be noted that 90 per cent of the plated fractures were able to return to the same job, and that anatomical position was obtained in 73.7 per cent of

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these—a higher per cent than those that were not plated. The great preponderance of bone fistulas, however, in the plated fractures is obvious, also that the average time out of work is prolonged, but there was no non-union in the plated group. What seemed particularly striking was the fact that in these protracted cases, which required long periods for treatment, 90 per cent of those plated eventually returned to the same job, in other words their economic use was restored. In some instances they were back on the job and still under treatment for bone fistulas, the longest of which persisted or recurred for two and one-half years, but there was not one that has not been completely healed for a year or more. There were two men over fifty-five years of age that presented an interesting complication, namely, a scar that tended to become eczematous or break down because of associated varicose veins of the leg.

For the past ten years Sherman⁶ and Wagner⁷ have plated practically all extensive open fractures of the tibia other than the badly comminuted, immediately following the débridement of the wound, leaving the wound wide open and using the Carrel-Dakin treatment. Infections have been exceedingly few. The plates are removed in five weeks and the wound is allowed to heal by cicatrization. Fractures with small wounds are simply dakinized and if after ten or twelve days they are sterile, plating is performed through a fresh incision. Auvray's² practice is very similar to Sherman's.

Elhason³ states "In severe cases of compound fracture of the tibia requiring frequent dressings it is desirable to apply a plate even in an infected wound until callus is sufficiently strong to resist displacement incident to movements of the leg during dressings."

Fagge⁵ believes "Primary plating is not generally advisable but cases occasionally occur particularly in the lower third of the tibia in which a reasonable degree of alignment cannot be obtained much less maintained by ordinary splint treatment." He uses immediate traction by Sinclair skate and Thomas splint. If by the time operation and débridement is performed the position is not satisfactory, plating is seriously considered and the wound is left unsutured. Plating, however, is the exceptional rather than the usual treatment.

Ashhurst¹ stresses the importance of securing anatomical reposition of the fragments not only to obtain ultimate good function but to lessen the period of disability. In open fractures of the tibia only one-fourth of the patients will obtain good function unless accurate reduction is secured. The average period of disability is seven months. In comminuted fractures, skeletal traction by the Steinman pin is superior to the Sinclair skate, a steel plate may be used when there are not more than two or three fragments.

Wilson and Cochrane⁹ believe that only in rare and exceptional cases of open fractures should metal plates be used, as they act as foreign bodies, are detrimental to wound healing, and various splints maintain reduction and alignment equally well.

CONCLUSIONS

I hold no special brief for plating, but these statistics and this investigation have been made with the sincere attempt to evaluate plating in open fractures of the tibia. I have no sufficient group of fractures treated by skeletal traction to compare with these, but until we have statistics that can show better end results, it seems to me that plating certainly cannot be ignored. However, each operator must establish his own indications and be prepared to meet the open fracture problem by more than one method. It must be emphasized that plating, to obtain the best results, must be done by one fairly versed in its technic.

Open fractures demand immediate treatment and this treatment logically will be (1) Treatment of the skin, (2) treatment of the wound, (3) treatment of the fracture. Successful results depend not only on *what* is used to accomplish this treatment, but *how* it is used.

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THE TREATMENT OF RECENT FRACTURES OF THE LONG BONES BY OPERATION

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THE climate of surgical opinion concerning the treatment of fractures is exceedingly foggy. The mists of many poorly founded individual opinions are beclouding the whole subject of treatment. Splendid progress has been made in fracture treatment in recent years, and even greater advances will be evident in the future.

For thousands of years fractures were fixed, the joints above and below immobilized by constricting splints and bandages. The soft parts—skin, muscles, fasciæ, nerves, and vessels—were left to take care of themselves, neglected.

This non-operative treatment is followed traditionally still in certain parts of the country. Out of this rigid, senseless system have gradually developed modern methods of treatment.

Sporadic efforts have improved treatment. Bardenheuer employed traction and countertraction and suspension. Buck also used traction and countertraction. The traction force was applied to the skin of the extremity with only relative efficiency.

Through the monumental work of Pasteur and Lister, the mortality of compound fractures was lowered. Lambotte, of Belgium, accepting Lister's conclusions, conceived the idea of diminishing the crippling due to fractures by a direct operative treatment. He had been at work in his own surgical laboratory some years and first published, in 1907 and again in 1913, a treatise upon the treatment of fractures by operation. Lane studied the effects of fracture on osseous tissue, and in 1893, 1897, and 1898, wrote on the operative treatment and proceeded to apply his theories to the limit.

Lambotte stands, in my opinion, as the originator and father of the idea of approaching fractures directly by operation. As Ashhurst has well stated, Lambotte's treatise on the surgery of fractures gives a concise, clear, comprehensive recital of the operative technic, which up to 1913 was unexcelled.

Isolated instances of operation for fracture occurred abroad and in America before the above date. In general, thirty years will cover the time during which fracture treatment by systematic operation has been developing.

The serious discussion of the operative treatment of fractures really coincides with the present technical perfection of pathological surgery. The aseptic régime, as practiced in general surgery, makes possible the treatment of fractures by operation. Rigid conformity to the established aseptic ritual is essential to success and is postulated in this presentation.

The treatment of recent fractures by operation is a safe treatment. The mortality is low, about as low as is the mortality following any major surgical

procedure The operative treatment of fractures is safe and stands on the basis of aseptic surgery

The conception of bone which exists today is more precise and comprehensive than that which has ever been held before Bone is no longer regarded as a relatively dry, inert, stable form of matter, serving as a passive framework of the body Bone is a flexible, living, changing tissue, an active organ, intimately associated with vital processes

The bony skeleton is a protection, a support, a means of locomotion, but it is related to certain physiological processes, it is a reserve of calcium Bone is the chief organ concerned in the formation of the cellular elements of the blood Bone tissue is sensitive to all extraneous influences The reaction of bone to trauma, to fracture, is recognized as a complicated series of events—the process of repair

This conception of bone emphasizes the importance of gentle, immediate, and, as nearly as possible, exact manipulative reposition of fracture fragments in order that the reparative processes may be least interfered with, to the end that ideal union may be accelerated The treatment of recent fractures by operation is based on the pathology of repair

Cowan, in a recent study on the healing of fractures, has called attention anew to the necessity for securing firm contact over as broad a fractured surface as possible so as to permit the reparative process to function at a normal maximum Under these conditions union will almost always occur Therefore, from the pathological basis of repair we feel the urge in treatment to secure firm bony contact Under certain conditions, this may be obtained by operation more precisely than by other methods The processes of union are facilitated by accurate apposition

Bancroft, in a recent study, says "From a study of the repair of fractures in human subjects, as well as in experimental animals, it is my conviction that the future of the repair of a fracture depends almost entirely on the immediate local treatment that the patient receives and very little upon the systemic metabolism of that individual That is, if a fracture is immediately treated in a manner which will replace as far as is feasible the fractured ends in suitable apposition and allow for the organization of the clot and the ingrowth of granulation tissue with its accompanying vessels, repair will inevitably follow "

Clinically, this means that if a fracture is so treated that there will be no constriction or obstruction to its blood supply and that there is sufficient immobilization to allow the growth of granulation tissue without its being constantly broken up and interfered with by the movement of the rough fractured ends of bone, repair will proceed in an orderly manner The processes of union or facilitated by firm reposition and apposition Every effort must be made to bring about these conditions

The pathology of repair underlies both the non-operative and the operative treatment of a fracture

We possess today certain methods of treating fractures, tried out and followed in different clinics in this country and abroad (1) A method of massage and mobilization introduced and furthered by Lucas Championiere, in France, the method now followed and practiced by Mennell, in London. Certain cases with little displacement lend themselves to this form of treatment. It is a time-consuming personal method, but under suitable circumstances remarkably effective. (2) The method of using a general anæsthetic and immediately setting the fractured bones, as practiced by Willis Campbell, of Memphis, Tennessee. The reduced fracture, checked by X-ray, is held in plaster-of-Paris splints. Mobilization is begun early enough to secure, under Campbell's supervision, results in fractures of the long bones comparable with some other methods. (3) The treatment with adhesive plaster skin traction, checked by X-ray, as used by Ashhurst, of Philadelphia. (4) The method of regional and local anæsthesia. This is as yet an experimental method applicable to certain cases and distinctly valuable. (5) The treatment by skeletal traction, as practiced in some form now in most clinics of the world. This is a recognized safe and efficient method of applying traction which at the same time permits movements of the joints contiguous to the fracture, a wonderful addition to fracture treatment. As practiced by Conwell, in Fairfield, Alabama, cases of fracture of the shaft of the femur in adults return to light work in from four and a half to five and a half months, and to heavy work in from six and a half to seven months. In a series of one hundred and ten cases, 80 per cent of them were treated by skeletal traction and suspension of the limb. Open reduction was done in this series only four times, twice for muscle interposition, and twice because of delayed union. Such in general are the non-operative methods ordinarily available.

(6) Treatment by operation, the direct approach. (a) Simple incision and replacement. This is applicable to a few fractures. LaFerté, of Detroit, has used this method in a large series of cases with little or no sepsis, with admirable functional results, with only an occasional slipping of the fragments after reduction. Plaster-of-Paris is used for fixation after operation.

(b) Simple incision, replacement, reduction maintained by absorbable suture, a method which may exceptionally be successfully used, but too often it permits slipping of fragments post-operatively.

(c) Simple incision and fixation by some form of non-absorbable material, such as plates and screws, as used in the Pittsburgh clinic of O'Neil Sherman. It is interesting that from this clinic I have records of one hundred cases of oblique and transverse fractures of the femur (not compound) in which there was displacement. In many of these cases there was an interposition of soft parts. They were all cases of fractures in healthy adults. Each case was treated by incision and the application of a steel plate held by screws. The patient was kept in bed and prepared for the operation ten days following the accident. He was fitted to a walking caliper at the end of ten weeks, and was walking with the caliper after ten weeks. The caliper was worn from nine to twelve weeks. The patient was bearing weight with support

after five weeks, and he was back at work on an average in six and one-half months. In 95 per cent of the one hundred cases there was no disability, there was slight disability in flexion of the knee in from 5 to 10 per cent only. In the one hundred cases, there was one case of secondary hæmorrhage which required the opening of the wound. There was one infection which was controlled. In each case an X-ray plate demonstrated solid union at the time of weight bearing.

This is a record of the employment of operation with non-absorbable material for fixation which, because of the control had over the individual patient, shows what this method can accomplish under such circumstances. It is a splendid demonstration of this method. The work and accomplishments of this clinic are a distinct contribution to the advance of the treatment of fractures.

The success of any of these briefly sketched methods available for treatment of recent fractures of the long bones is dependent in the first and last analysis upon the fact that one person is primarily concerned with the treatment from inception to finish, and that he alone is responsible. The decision upon the method of treatment in a particular case is less a question of the non-operative versus the operative treatment than it is the selection of those cases which are suitable for each form of treatment.

With our present knowledge of the results of ideally conducted non-operative methods and the results of ideally conducted operative methods, it is impossible to state a final opinion of the applicability of one method of treatment to a certain fracture. Our opinions will necessarily vary. Standardized fracture treatment is as undesirable as it is impossible of realization. New knowledge and new methods will continue to cause us to change our attitude toward the treatment of individual fractures.

The operative treatment rests upon bases that are at once solid, sound, and enduring, namely, established asepsis and the pathology of repair.

In every fracture we are confronted with its peculiar individual characteristics, its special problems. A fracture is an injury to a complicated and intelligent mechanism. The will is involved in every fracture, it influences the recovery of function. The recovery of the normal functioning of the whole organism is at stake, not merely the healing of a broken bone.

CERTAIN FACTS CONCERNING THE OPERATIVE TREATMENT OF FRACTURES

The operative treatment of a recent fracture necessitates the finest technique in surgery and a suitable equipment.

The treatment of recent fractures in childhood by an open operation is rarely indicated.

The operative treatment requires a careful approach to the fracture. These approaches are undergoing continuous scrutiny in order that trauma may be minimized. Henry, of Dublin, and Thompson, in Texas, have each contributed constructively to this phase of the subject.

It has been held that the use of the operative incision itself in approach-

ing the site of fracture tends to, and actually hinders, the repair of the fracture. The operative incision properly placed and made by sharp dissection does not appreciably hinder repair.

It has been likewise held that the placing of a plate upon the fragments of a fracture retards the formation of callus. My feeling on this point is that even though callus at the exact site of the plate is sometimes absent, the presence of the plate offers no *material* disadvantage in the ultimate repair of the fracture.

The indication of the use of the open operation in the treatment of a recent fracture is that by the open operation there is obtained an earlier return to a more nearly normal function than by other available treatment. The treatment of recent fractures by open operation is no longer a last resort when other methods fail, it now occupies an established place in surgery, it is in many instances an initial method of choice.

We must always assume, in considering the use of the operative treatment, that in the individual instance

- 1 The highest degree of safety will obtain
- 2 The surgeon and his assistants are skilled in the treatment
- 3 The surgeon possesses ability greater than that legally required
- 4 The surgeon has available the necessary instruments and apparatus
- 5 The use of the form of anæsthesia suitable to the case will be skilful
- 6 The final and exact procedure chosen in the operative treatment of a given case is appropriate
- 7 The pre-operative and post-operative care is adequate
- 8 By this treatment the involved or contiguous joints are moved as early as possible

May I enumerate a group of fractures in which it has already been pretty satisfactorily demonstrated that it is unwise to use closed methods and in which treatment by operation is appropriate

Many fractures into joints with displacement of fragments

Fracture of the great tuberosity of the humerus

Fracture of the surgical neck of the humerus with dislocation of the head of the bone

Displaced condyles of the humerus not held by acute flexion

Fracture of the olecranon

Certain elbow fractures in adults

Certain metacarpal fractures

Certain carpal fractures

Certain fractures of the head and neck of the radius

Fractures of the radius with deflection of the fragments toward the ulnar side

Irreducible fractures of the shaft of the femur

A displaced femoral condyle

Fracture of the patella

Certain spiral fractures of the bones of the leg

Certain metatarsal fractures

Certain fractures of the os calcis

In the large and important group of fractures of the neck of the femur, we are coming to understand more and more the limitation of the treatment by abduction. It may some day be possible to select, with greater accuracy than today, from this group those cases in which the abduction treatment is not suitable. Treatment by operation may be found satisfactory for certain cases of fracture of the neck of the femur. This whole group of cases here stated will vary from time to time.

It is difficult to state what amount of displacement is consistent with a satisfactory result. It is not primarily the anatomical result we want, it is the best functional result obtainable. The approximation to an anatomical result is desirable because it is recognized that the factor of position is an important one in determining function. We may have a poor anatomical result and good function. That doesn't mean, however, that we should permit poor anatomical alignment in our method of treatment. We must always, I believe, hold out as a goal of our treatment, function as of first importance and permit the other factors entering into the problem to adjust themselves as is most logical.

Conclusion —We have in the operative treatment of fractures a sound, safe, and efficient method. We will choose it primarily in certain cases because it yields the best results. *We will honestly try in all doubtful cases the non-operative traction method first.* We will find that the honest use of skeletal traction will diminish the number of cases requiring primary operation. In adults, ten to fourteen days may be employed in using the non-operative method before resorting to operation.

If one is master of the general principles and technical details of both the non-operative and the operative treatment of fractures, is informed as to the results of such treatment, has a complete knowledge of the proper use of massage and active movement, and can secure the patient's complete cooperation, one's vision of the surgical treatment applicable to a given case of fracture of bone will be so broad, one's selection of the treatment will be so wise, and one's execution of the treatment chosen will be such that the result both functionally and anatomically will be the best obtainable for that particular individual under the existing conditions.

DISASTERS FOLLOWING OPERATIVE TREATMENT OF FRACTURES

BY WILLIAM DARRACH, M D
OF NEW YORK N Y

In adopting the operative treatment of a fracture the surgeon should visualize potential disasters in order that their danger may be minimized. In calling attention to certain complications and difficulties it is usually possible to collect statistical data which will present a picture of mathematical probabilities. Unfortunately, such a portrayal cannot be offered in this instance. Figures are available from a few men whose experience has been fairly extensive. But most of the disasters do not occur in such hands, but rather do they visit those who do not appreciate the need for careful attention to detail nor the importance of publishing unfortunate results. One does not have to operate on many fractures to become personally aware of the difficulties and dangers. Nor does one have to see much of the work of others to realize that his own experience is not very exceptional. Accidents occur in the best regulated families but they occur much more frequently where regulations are slipshod and careless.

Infection is the commonest disaster associated with the open method. The result may vary between a little delay in healing of the wound to severe sepsis and amputation or death. One of the main factors in combating infection is the ability of the tissues to resist the invading organism. This depends very largely on the circulation in the tissue involved, not only on the normal capacity of the vessels but on their ability in emergencies to carry to and from the affected area much larger amounts of blood. Fractured bones are as badly equipped as any tissue in the body to meet this need. First the blood supply of bone is comparatively scanty. The vessels of the periosteum and, to a far greater extent, those within the bone are in dense resistant tissue. Many of the vessels are torn across by the fracture and the periosteal stripping that occurs with any displacement of fragments. As in warfare the success of any engagement with the enemy depends largely on the means of communication. Only a certain number of men or trucks can pass over a road of a certain width in a certain time. The narrower and the fewer these roads are the greater will be the embarrassment to the army when an emergency arises. This periosteal stripping is usually greatly increased by the manipulations of reduction. The wonder then is not that bone is so often infected when exposed, but rather that it ever escapes. When the bone does become infected the area may be limited to one surface of the bone, so that the process of repair may proceed at almost normal rate in the rest of the bone and strong union result. On the other hand, the death of tissue may involve the whole diameter of one or both fragments, resulting in most distressing loss of substance.

If it is realized that bone and especially traumatized bone, is far more susceptible to infection than other tissues, the meticulous precautions necessary in the operative treatment of fractures will be undertaken more conscientiously. The so-called "Lane Technic" is neither faddish nor foolish, but distinctly worth while. It should be broken only when its strict observance unnecessarily prevents or delays the successful accomplishment of the operation. Longer and more thorough skin preparation is necessary, especially when splints and bandages have allowed the outer layers to accumulate. Nothing should enter the wound that has been touched even by a gloved hand. The tissues should be handled gently and the periosteum left in contact with the bone wherever possible.

Hæmorrhage—Fatal or severe hæmorrhage is more often due to faulty approach than to imperfect control. Most of the long bones can be reached by "dry" routes. Some men do not take the trouble to work these out. I have seen a fatal hæmorrhage from a femur where the external approach was used. I have seen several femurs operated on by the anterior approach where no ligatures were required. The site of fracture should be exposed by a route which will result in the least injury to overlying soft parts. When a large vessel has been injured by the original trauma alarming hæmorrhage may occur as the field is exposed. Such a disaster need not weigh quite as heavily on the conscience of the operator as one that results from his own ignorance or carelessness.

Vascular Interference—Delayed or non-union may result from operative interference with the blood supply. Careless approach and wounding of important vessels may seriously impair the circulation. Wholesale stripping of periosteum undoubtedly delays union. The most serious effect of vascular interference is its predisposition to infection.

Faulty Material—Reliable material is essential to successful treatment of fractures no matter what the method used, but this is especially true in the operative method. It is bad enough to have plaster crumble or crack or to have a traction cord break but they can be replaced rather easily. When a post-operative film shows that a plate has broken and the wound must be reopened it is indeed a tragedy. Today there is apparently a very serious situation in this country. During or soon after the war there was a sudden demand for plates and screws and a large supply was made up of inferior material and workmanship. Two accidents recently have occurred to us due to our failure to carefully examine a new shipment of plates and screws. One plate bent and a second one broke, the latter while the femur was encased in plaster. A later checking over of our supply showed the large majority of the plates faulty and almost all the screws carelessly finished. It was shown long ago that wood screws will only hold a very short time and that self-tapping machine screws must be used. When the grooves are not well cut or the heads off centre or the notches improperly placed poor workmanship will result. One always hesitates to use plates and screws but unless one can be sure of their holding the risk becomes too great and disaster too

likely. It is hoped that this warning will lead to a careful inspection and return of all material of this type. The matter has already been taken up with the manufacturers but if the dealers can receive from all over the country these faulty goods the remedy will be more promptly found. Other forms of material, sutures, whether silk or fascia or chromic or tendon, may prove to be weaker than expected and result in distressing situations.

Faulty Technic—Many of the disasters of operative treatment can be directly traced to poor technic. Careless examination of patient and X-ray evidence, unsound appreciation of what can and what cannot be accomplished, faulty approach, failure to provide proper tools, clumsy procedure, rough handling of tissues, careless immobilization and after-care are far more often to blame than the method itself.

Delayed Decision—Only too often is the operative method used as a last resort. Other methods are tried and only when the opportunity has gone forever is the attempt made by the open method to accomplish something which might have been comparatively simple and safe in the early stages of repair. Such instances of omission or delay are just as much disasters as are those where the operative method is improperly used.

Faulty Judgment—The disasters due to errors of judgment are often humiliating, when we leave a fracture we have successfully reduced without proper fixation, only to have the displacement recur, when we misread an X-ray to find the operation unnecessary, when we believe we can obtain a reduction and find we have only made it worse, when we concentrate on the outstanding lesion to discover later that we have overlooked an associated injury, when we attempt to repair a deformity too soon after an infected fracture. These are all disasters but often forgivable.

SUMMARY

The disasters which may follow the operative treatment of fractures should be known and faced. These are due to

- 1 Infection. Bone is more susceptible to infection than any other tissue. Unusual precautions must therefore be taken.
- 2 Hæmorrhage. More often due to faulty approach than imperfect control.
- 3 Vascular interference.
- 4 Faulty material.
- 5 Faulty technic.
- 6 Delayed decision.
- 7 Faulty judgment.

DISCUSSION. DR WILLIAM L. ESTES, of Bethlehem, Penna., said that the keynote for the treatment of fractures was struck by the Fellow who spoke of faulty methods and of the chemical possibilities of the blood and organs generally, and who finally concluded that after all, the proper thing was the conservation of the blood supply and the proper adjustment of the fragments.

The proper blood supply not only depends upon the direct injury to the tissues and blood vessels, to be prevented by securing fixity of the broken bone by some object from without perhaps, but also upon the possibility, and frequently the existence of *tension* in the soft tissues, from hæmorrhage for instance, on account of lacerated tissue and displaced muscles. In order to prevent this the surgeon ought sedulously to avoid tension, and should prevent the occurrence of tension. The speaker then showed a series of lantern slides illustrating various points in his own methods of dealing with complicated fractures.

DR JOHN B WALKER, of New York City, spoke upon the late results of fractures of the long bones of the World War cases. The sick and wounded records of the office of the Surgeon General of the Army and the later records of the Veterans' Bureau furnished an unusual opportunity to secure important data concerning injuries, especially fractures. Battle fractures ranked for death first below tuberculosis which was number four among diseases, influenza, lobar pneumonia, bronchopneumonia and tuberculosis—but fractures were relatively much more important as the cause of loss of time and permanent disability.

The most serious cases were the gunshot fractures of the femur and it was in this class of cases that the greatest improvement in the treatment of fractures was developed during the war.

During the Civil War there were 6549 fractures of the femur with 3434 deaths, a fatality of 52 per cent, during the World War 3850 fractures of the femur with 971 deaths, a fatality of 2 per cent. Of the deaths following fracture of the femur 43 per cent occurred within the first three days and 55 per cent within the first seven days. In the Civil War there were 7888 cases of fractures of the humerus with 1639 deaths, a fatality of 21 per cent, during the World War 4069 cases with 414 deaths, a fatality of 10 per cent.

There were 147,651 gunshot injuries, 25,272 or 17 per cent were fractures. There were 12,192 deaths and of these 2751 or 23 per cent were due to fractures, and of these deaths 47 per cent occurred within the first three days and 60 per cent within the first seven days. The loss of time due to fractures was 35 per cent. There were discharged for disability 25,187, of which 11,740 or 47 per cent were due to fractures.

Amputations—Four thousand one hundred seventy-eight amputations were performed, of the femur, 1817, tibia and fibula, 1190, humerus, 727, radius and ulna, 444. Seventy-three per cent were performed within the first fifteen days. No one soldier lost both arms and both legs, only one soldier lost both legs and one arm and not one lost both arms and one leg. Twenty-two lost both legs at the thigh, forty both legs below the knee and seven lost both forearms below the elbow.

The late results of some of these cases after six years are as follows. Of the total cases only 16 per cent had a disability of less than 10 per cent, 44 per cent had a disability of between 10 and 29 per cent, 16 per cent had a disability between 30 and 49 per cent, 15 per cent had a disability between

50 and 79 per cent, 6 per cent had a disability between 80 and 99 per cent, 3 per cent had a disability of 100 per cent

Femurs—Fifty-one per cent of the femurs required more than five years to reach their stationary level of improvement, a level reasonably certain to continue through life. At this time only 5 per cent had a disability of less than 10 per cent, 47 per cent were rated between 10 and 49 per cent disabled and 48 per cent were rated between a 50 and a 100 per cent disability

Tibia and Fibula—Forty-nine per cent required more than five years to reach their stationary level, at that time 17 per cent had a disability less than 10 per cent, 72 per cent were rated between 10 and 49 per cent and 11 per cent were between 50 and 100 per cent

Humerus—Fifty-five per cent required more than five years to reach their stationary level, at that time 10 per cent had a disability less than 10 per cent, 57 per cent were rated between 10 and 49 per cent and 33 per cent were between 50 and 100 per cent

Radius and Ulna—Forty-nine per cent required more than five years to reach their stationary level, at that time 17 per cent had a disability less than 10 per cent, 55 per cent were rated between 10 and 49 per cent and 28 per cent were between 50 and 100 per cent

These ratings seem unusually high and the duration of the disability much prolonged. However, 80 per cent were compound and due to severe battle injuries, the fractures became septic—osteomyelitis developed in 74 per cent with much destruction of tissue, resulting in lasting deformity with much impairment of function. Also, an associated nerve injury in 14 per cent of the fracture cases was responsible for increasing the prolonged duration of disability

DR DALLAS B. PHEMISTER, of Chicago, Ill., spoke about the influence of necrosis of the head of the femur upon union in cases of intracapsular fracture of the neck of the femur, and the ultimate functional results

The head becomes completely necrotic in many cases of intracapsular fracture of the neck of the femur. When this happens non-union usually follows. There may be revascularization and connective tissue invasion of the dead head following hypertrophy of the vessels of the round ligament. In that case it may be gradually absorbed and partly replaced by new bone. This comes about slowly and the head casts a heavier shadow in the X-ray than the surrounding living bone which undergoes atrophy of disuse. In case of impaction there may be non-union between the necrotic head and the distal fragment and at first the functional result may be fairly satisfactory. However, the head eventually goes to pieces. The weight-bearing portion gradually breaks down as a result of walking and there is more or less absorption of the necrotic portion by the invading connective tissue, so that eventually a markedly deformed and poorly functioning head is the result

In other cases of intracapsular fracture, the head fragment receives sufficient nutrition to remain alive. In some cases the fracture unites and a good functional result is obtained. In other cases the fracture remains

united and the head undergoes atrophy of disuse along with the other bones of the region

DR JAMES MORLEY HITZROF, of New York City, said that the great difficulty in teaching fractures to the average student is to give him some perspective from which to work. In looking at it from a great many different angles the speaker had evolved these four classes

1 *Fractures which will give a good result with any ordinary treatment* In that group would be included the fractures without displacement, fractures with slight degrees of displacement easily corrected by simple manipulation many of the fractures in children especially the green stick fractures, and some of the fractures which may be treated by the simpler forms of traction. Here also may be included many fractures of the clavicle ribs and scapula

2 *Fractures that require special treatment, skilfully applied, for a good result* This includes perhaps the largest variety of bone injuries, such as for example the fractures about the wrist-joint, the fractures about the ankle-joint, fractures of the patella and olecranon, fractures of the long bones with varying displacements and some of the compound fractures

3 *Fractures that may result badly with any form of treatment, but which require special treatment for the best possible results* Nos 2 and 3 overlap necessarily. There may be a considerable difference of opinion as to where a fracture might be placed. As a rule in Group 3 are included the more serious types that one would find under Group 2. These would include the fractures which involve the joints, fractures of the neck of the femur, the pelvis many of the compound fractures and certain of the fractures of the vertebra. In this group he would also include fractures of the tarsal bones such as the os calcis and of the carpal bones such as the scaphoid. Many of the skull fractures may well be placed here

4 *Fractures which will give an indifferent or poor result no matter how skilful the treatment*

Students should be taught the emergency treatment. All medical students should receive sufficient instruction and experience along practical lines to learn to recognize that they are dealing with a fracture, in order to avoid additional injury by injudicious manipulation. They should be taught the practical methods of splinting the injured limb with special attention to the use of the Thomas splint. They should also be taught that each fracture is a surgical emergency which should be transported carefully and treated promptly, and if possible an X-ray picture should be made as it is of great value in determining the character of the bone injury. That does not mean that an X-ray is necessary to determine there is a fracture. If an X-ray can be made immediately it is of great help in determining the character of the bone injury

Then, by the use of one of the above four groups, or some similar grouping they should be taught the simpler methods applicable for the treatment of the first group. Emphasis should be laid upon the necessity for a prompt consultation, or of prompt splinting and transportation of the other three

TREATMENT OF FRACTURES

groups to a place suitable for their prompt treatment. To him this means a hospital wherever and whenever it is possible.

All of the above things mentioned are functions of the ordinary man, things which he can learn with very little experience and which put no undue strain on his ability, and do not require him to learn all the complicated methods which are of necessity learned in a clinic where they are used. It isn't so much the method as it is the man behind the method that determines the outcome.

One of the factors surgery is facing now is the fact that there is a great deal of unskilled treatment applied in the use of methods which in the hands of the proper men, skilfully applied, are successful. He thinks teachers will have to revise their teaching to teach the men how to do the simple things and to call for help and call early and often when they get into the more serious matters.

DR EMMET RIVFORD, of San Francisco, Cal., said that it is a fitting time to realize that there are many methods of treating fractures, and that each one of them has its advantages when properly applied.

It is a good thing that there are different ways of doing things. Multiple methods simply add to the elasticity of one's armamentarium, for methods are really instruments.

One should not be a faddist and try to treat a large percentage of his fractures in any particular way, whether it be open operation or otherwise. There are certain fractures that unquestionably are better treated by open operation and one should be able to recognize such fractures in the beginning and not leave operative treatment for a last resort.

There are other fractures which are better treated by traction, others by splinting. One should be able to tell ahead of time which method of treatment he should use. It is not fair to the patient to operate only as a last resort, because if nature has already produced a fair union, even though it be in malposition, it is asking a good deal of her to do it all over again after one has interfered in an open operation.

DR DEAN LEWIS, of Baltimore, Md., remarked that the most common cause of non-union, interposition of soft parts, had been somewhat neglected of late. In his experience this is by all odds the most common cause. Interposition of soft parts also prevents reduction in many cases and when reduction cannot be obtained by ordinary methods, an open reduction should be made, for then the cause of non-union may be overcome.

Injury to the nutrient artery may play a rôle in non-union, especially in fractures through the shaft of the femur.

Doctor Ashhurst has brought out the fact that it is not necessary to have accurate reduction in order to obtain good functional results. This applies particularly to children, and it cannot be emphasized too often. Dr V. C. David some years ago analyzed the results in some seventy-five fractures of the femur in children. Deformities were corrected with growth, and in some

the extremity in which the fracture occurred was longer than the normal Epiphyseal growth on the fractured side seemed to be stimulated

There is one disaster that may occur with fractures which has not been mentioned, that is, Volkmann's palsy. It is a crippling disability. It is the result usually of an attempt to secure an early accurate reduction of a fracture. This palsy occurs most frequently after supracondylar fractures of the humerus and femur, after Colles's fracture, and fractures through the lower end of the fibula. It is due to venous congestion, and a subfascial hematoma in the antecubital and popliteal fossæ, interfering with venous return and the development of a collateral circulation, is the principal etiological factor.

This palsy may occur when no cast has been applied, and if palsy is threatened, the indications being pain, swelling and cyanosis of the hand, and a tense antecubital fascia, an incision should be made into the fossa to relieve the tension.

Doctor Estes has spoken about the antiseptic effect of silver. Silver wire apparently kills tissue also, for in many of the cases of non-union which he has seen silver wire has been used. No repair occurs about it and he believes that it should be discarded in the treatment of non-union and the open reduction of fractures.

DR JOHN H. JOPSON of Philadelphia, said that Doctor Ashhurst and he had been interested for some years in conducting a regional Fracture Conference in Philadelphia, started through the influence of the Central Committee under the leadership of Doctors Scudder and Ashhurst. He supposed the standard of practice of its members represented pretty well a cross section of the surgical practice in Philadelphia and the larger cities in the vicinity. One would get the impression, from talking to many of these gentlemen beforehand, that they were very radical in the treatment of fractures, that open operation was the only thing, and if one didn't do it and didn't stand up for it he was ultra-conservative and a back number.

He remembered very distinctly that in one of their meetings each member was asked to present his statistics for the number of cases treated by the open operation method. The surprising thing was that there was comparatively little difference in the percentage of cases which were operated on by the open method by the surgeons thought to be radical and those deemed conservative.

Doctor Scudder had made out a strong case for the operative treatment of certain fractures, supported by admirable statistics. The list of fractures which he enumerated as requiring open treatment is practically the same list which Doctor Jopson teaches his own students as requiring operation.

GAS GANGRENE IN COMPOUND FRACTURES

BY FRANK K. BOLAND, M.D.
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FROM THE DEPARTMENT OF SURGERY OF EMORY UNIVERSITY

GAS gangrene probably is the most serious complication of compound fractures. While the treatment of the condition furnished a conspicuous part of the surgery of the World War, fortunately its incidence in civil practice usually is rare.

However, in the eighty compound fractures in negro patients treated at the Emory University Division of the Grady (Municipal) Hospital, Atlanta, during the seven years from 1922 to 1929, gas gangrene developed in fifteen cases, a percentage of 19. During the same period, in the same institution, the disease was recorded in five other cases, not compound fractures. One of these cases followed diabetic gangrene. Glycosuria has been reported as being found in gangrene due to gas-forming bacilli, but this patient was known to have diabetes before gas gangrene appeared.

During the same period I saw two cases of the malady in white patients. One was a young woman the victim of an automobile accident. The muscles of her arm were severely macerated, without fracture. The other patient was a physician who contracted the infection through a small wound in his finger received in his office. Amputation was done in the first case, and débridement in the second, both patients died.

Also, during the same period of seven years, among the ninety-seven cases of compound fractures treated in the white division of the Grady Hospital, seven developed gas gangrene, a percentage of about 7. The nature of the compound fractures in both classes of patients seemed equally severe, so that it would appear that the negro is more susceptible to the disease than the white man, or that his resistance is less.

The common habitat of the various anaerobic gas bacilli is thought to be cultivated soil and animal excreta, and it may be that the apparent susceptibility of this class of negroes is due to uncleanness. On the other hand, Gage¹ believes that all kinds of wool and woolen goods harbor the microorganisms. He not only found gas bacilli in the wool pads interposed between powder and shot in ordinary bullets, but also grew them in cultures taken from woolen clothes just returned from a pressing club, and in samples of unused cloth taken from a tailoring establishment.

The bacteria usually described as causing the condition are (1) *B. welchii*, or *B. aerogenes capsulatus*, called by the French *perfringens*; (2) *Vibrio septique*, probably identical with the bacillus of malignant œdema; (3) *B. œdematiens*; (4) *B. sporogenes*, neither causal nor gas-producing, but said to be most responsible for the characteristic odor of the disease. In addition to these, several other bacteria have been named as etiological factors, such as *B. fallax* and *histolyticus*. The *B. welchii*, although it is the most frequently found, and was the only organism found in this series, and is the greatest gas producer, rarely is the sole causative agent, except in cases of localized gangrene. It is by symbiosis, the combination of two or more of these bacteria, and

probably aerobic germs, such as streptococci, that the most virulent types of the disease are produced. The bacillus of Welch was demonstrated by smear or culture, or by both, in all these fifteen cases except two, and in these the clinical signs and history established the diagnosis. Blood cultures were tried in several cases without success.

I am indebted to Dr. Jack C. Norris, pathologist in the Grady Hospital, for the following description of cultural methods used in the detection of gas bacilli. "Material is obtained directly from the wound, either by sterile swab or sterile aspirator, and is placed into ten cubic centimeters of a fresh meat extract bouillon. This bouillon is faintly alkaline, and contains 1 per cent dextrose. After the inoculation of the culture media, a layer of sterile liquid petrolatum, approximately 1 centimeter in thickness, is added. This oil settles over the top of the bouillon, and insures practical anaerobiosis. It is then incubated at 37.5°C.

"The culture is noted at six, eight, twelve, sixteen and twenty-four hours. The appearance of gas bubbles after six hours indicates a specific gas former. The appearance of gas bubbles sufficient to penetrate the oil layer and rise to the surface is almost a positive indication of the presence of gas bacilli. Smears are made at intervals, and if the large Gram-positive bacillus is found, animal inoculations are made, and the bacteriological diagnosis confirmed.

"This method of bacteriological determination seems to be most satisfactory, especially for *B. welchii*, which is the organism usually found in this section."

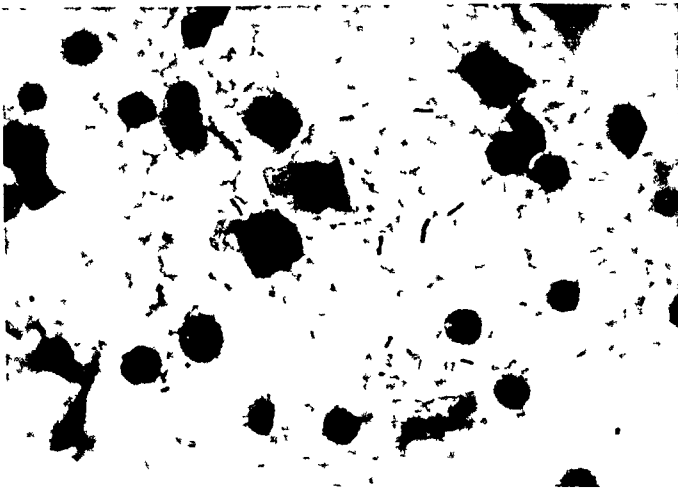


FIG. 1.—Smear from deep tissue

The tissues attacked by these putrefactive organisms must first be damaged by direct trauma or by interference with the blood supply. While bacteria may enter the body through the alimentary canal, it is probable that in compound fractures they enter directly through the wound. While the disease is essentially one of muscle tissue, occasionally it begins in other tissues. Nearly always, however, muscle is the starting point, the infection spreading rapidly through the fibres to the end, when it attacks the next muscle beyond. The infection tends to travel longitudinally, rarely transversely.

The muscle fibres become separated from the surrounding interstitial tissue by a clear space which becomes filled with septic fluid, bacteria and gas. An X-ray film may show the gas before it is detected by crepitation. The muscle is at first dull and opaque, brick red in color, resembling cooked meat, it does not contract when pinched nor bleed when cut. Bubbles may now be pressed up and down between the fibres. Great swelling of the limb occurs, well described by Wentrob and Messeloff² as tense, not giving the fluctuation of an abscess or the pitting of œdema. The color changes to green, brown or black, a bloody exudate comes from the wound, and gas can be felt in the tissues over an area considerably greater in extent than that of the dead tissues. The characteristic odor, which must be encountered to be recognized and described, is extremely foul and sickening.

In this series of fifteen cases of gas gangrene in compound fractures, eleven patients were males, and four females, ages ranged from five to fifty-

GAS GANGRENE IN COMPOUND FRACTURES

two years, two fractures were due to gunshot wounds, two fractures involved the upper extremity, and thirteen the lower extremity. Six patients died, giving a mortality rate of 40 per cent. No autopsies were performed. The shock of amputation apparently was the immediate cause of the demise of one or two of the patients, but since the operations were done to cure gas gangrene and the patients would have died without such treatment, gas gangrene must be assigned as the cause of death. One of the gunshot cases died and one got well. All published series give a larger number of cases of gas gangrene in fractures of the lower extremity than in fractures of the upper extremity. Such records no doubt are due to the fact that the lower extremity is more exposed to infection from the soil than the upper extremity, and also to the fact that the tight muscles about the tibia furnish better ground for the propagation of anaerobes than the looser muscles of the forearm. Is it not also true that compound fractures are commoner in the leg than in the forearm?



FIG. 2.—*B. welchii* shown in culture grown from case of gas gangrene. The culture is young, and spore formation does not appear.

Signs of the disease may be noticed in from six hours to three days after injury, the average time being about twenty-four hours. It is difficult to enumerate the different signs and symptoms in the order in which they appear. Certainly no single symptom always appears first with the regularity that pain, as stated by John B. Murphy, is always the first symptom to be noted in acute appendicitis. However, it has been commonly observed how often the first symptom of gas gangrene is a pulse rate higher than should be expected from the patient's general condition. Instead of 80 or 90, it is 110 or 120. Sometimes the temperature keeps pace with the pulse rate, and sometimes it does not. The leucocytes usually run from 15,000 to 20,000. At the same time the patient may complain that the dressing is too tight, and he seems to be restless and anxious.

At this juncture it would be better if the fracture is immobilized in an apparatus which permits easy and adequate inspection of the limb, because such an examination should be made without delay. The color changes described are not of much value in negroes. The order in which the other symptoms appear is not at all constant. Smear and culture should be made immediately, and may prove positive as early as six hours after the injury. The X-ray does not always show gas but sometimes will demonstrate it.

before bubbles are seen. As a rule the odor is an early sign, but in two or three of these cases it was not definite until after the culture was positive.



FIG 3.—Gas gangrene in gunshot fracture of knee joint

The treatment of a compound fracture complicated with gas gangrene resolves itself into treating the gangrene, and treating it as promptly and vigorously as possible. If its spread is not controlled death from septicemia, or possibly gas embolism, is almost the invariable outcome. The alignment of the broken bones can be taken care of later, and the patient will be fortunate indeed if, after he is rid of the lethal infection, there are bones to be aligned. More than likely the fracture will disappear in an amputation. Only one of these cases was cured by debridement alone, while another one was cured by débridement, and later multiple incisions. Four were cured by amputation alone, and three cured by debridement, and later amputation. Four died following débridement and amputation, one died after amputation alone, one died after linear incisions alone.

The idea of operative treatment is the excision of all obviously and supposedly damaged tissue,

preserving as much skin and as many important nerves as possible. The adjacent tissues should be widely exposed to the air by multiple longitudinal incisions. Many different kinds of after-treatment have been proposed, but nothing in our hands has given better results than the application of the

GAS GANGRENE IN COMPOUND FRACTURES

Carrel-Dakin technic Dressings should be loose and few in order to discourage the growth of the anaerobic bacteria by the admission of oxygen

The involved parts and the general progress of the patient should now be watched diligently Upon the appearance of the first signs of the extension of the disease, either local or constitutional, further débridement should be done, or better a high amputation The aim must be to save the patient's life, and not his leg or arm In the case of the physician who died from gas gangrene of the arm, if he and the rest of us had not thought so much of how incapacitated a laryngologist would be with one arm gone, and had amputated instead of débrided, we might have avoided a mortality The routine care of the patient's septic condition is most important Blood transfusion does not seem to produce appreciable results

The last eight patients in this series were given the anaerobic antitoxin of a New York firm, the first four being given the perfringens antitoxin, the last four being given the more efficient polyvalent preparation In the last four cases the antitoxin



FIG 4—Gas gangrene complicating compound fracture of tibia and fibula

was administered both as a prophylactic and therapeutic agent the average prophylactic dose being twenty cubic centimetres, and the average therapeutic dose being fifty cubic centimetres repeated once or twice every twenty-four hours Intravenous injections were preferred and generally employed Two

of the seven patients who did not get the antitoxin died, and four of the eight who received antitoxin died. This sounds discouraging, but other factors must be considered. Certainly in two of the patients who received antitoxin and died, surgical shock played a large part in the fatal termination. This series is too small to draw any kind of conclusions as to the value of antitoxin in the treatment of gas gangrene, but it is evident that the violence and rapidity of the infection differ materially among patients, whose resistance manifestly is not always the same. B. H. Clifton³ reports a case from the white division of the Grady Hospital which he believes was saved by the antitoxin after shoulder-joint amputation apparently had failed.

At present all patients with compound fractures and other wounds which might give rise to gas gangrene, in addition to tetanus antitoxin are given on admission polyvalent anaerobic antitoxin as a prophylactic measure. It is advisable also that smears and cultures be taken at once. No doubt the dose of antitoxin should be larger than heretofore, probably fifty cubic centimetres as a preventative, and 100 to 200 cubic centimetres as treatment. On account of the small demand for the antitoxin its cost is high. The reactions from some of our small doses has been marked with temperature as high as 105° and urticaria persisting for ten days.

Although the toxin produced by the tetanus bacillus is claimed to be a thousand times more lethal than that of *B. welchii*, it is difficult to conceive how the serum prophylaxis against gas gangrene can ever become as successful as antitetanic serum. The period of incubation of the gas bacillus infection is too short. The more rapid course of this disease is said to be due to a constantly occurring exhaustion of the suprarenal glands.⁴

Simple fractures require more consideration from the surgeon than reading an X-ray report and the application of a splint, compound fractures demand unremitting care to avoid serious contamination and give the best possible end-result, while the attention and judgment necessary to save a limb or life in a compound fracture infected with gas bacilli equals that of any problem in surgery. Lister achieved his first step toward immortal fame by his successful treatment of a compound fracture.

CASE REPORTS

CASE I—Male, thirteen years of age. Admitted to the Grady Hospital (Emory University Division) November 11, 1922. Compound comminuted fracture of the left tibia and fibula, from automobile accident. Patient given 1500 units tetanus antitoxin on admission, as in all cases. Wound debrided and closed, plaster cast applied, with window. November 13, patient became stuporous, pulse rose from 100 to 142. November 15, foul odor from wound, sutures removed, bubbles of gas escaped. Smear showed *B. welchii*. Carrel-Dakin treatment instituted. Swelling and crepitation extended, general condition grew worse. November 17, high guillotine amputation of thigh. November 18, patient died. No gas-bacillus antitoxin used.

CASE II—Male, twenty-four years of age. Admitted November 13, 1924. Compound fracture of left fibula, from fall from window to ground. Wound cleaned with iodine, cast applied. Temperature and pulse normal on admission, third day pulse 110, temperature 101°. Discharge developed typical gas-bacilli odor. Smear positive for *B. welchii*. November 18, amputation lower third of leg, December 10, secondary closure. Good recovery. No gas-bacillus antitoxin used.

GAS GANGRENE IN COMPOUND FRACTURES

CASE III—Female, thirty-seven years of age Admitted December 21, 1924 Compound fracture of tibia and fibula, from automobile accident Wound debrided and closed immediately, plaster cast applied December 23, patient complained of severe pain in leg, temperature 99° , pulse 80 Dressing removed, typical odor and discharge discovered Smear positive for *B. welchii* December 25, guillotine amputation lower third of thigh, patient died same day The pulse and temperature appeared to be but little affected by the disease No gas-bacillus antitoxin was given

CASE IV—Male, six years of age Admitted July 11, 1926 Compound fracture of right ulna, from being hooked by a cow Patient began to complain of severe pain a few hours later, when his mother noticed marked swelling of forearm, and brought him to the hospital at once On admission, which was not more than six hours after the injury, temperature was 101° , pulse 110, child was very restless, and general condition was poor One hour later temperature was 103° , pulse 130, respiration 30, leucocytes 17,600, polymorphonuclears 88 per cent Gas-bacillus odor was present, and the swelling extended to the middle of the arm, and to the wrist X-ray showed fracture of the ulna, and gas in the tissues Amputation was done the same day The patient's temperature dropped to normal, and remained practically normal the six weeks he was in the hospital Unfortunately a culture was not made from the wound until the second day, when it showed a long Gram-positive bacillus with some spore formation, morphologically consistent with *B. welchii* No gas-bacillus antitoxin was given Recovery was satisfactory

CASE V—Female, fifty-two years of age Admitted September 1, 1926 Compound fracture of left tibia and fibula, from street accident On admission, two hours after injury, crepitation was felt in the surrounding tissues, but no gas bubbles could be expressed A smear taken at this time was negative Leucocytes 18,160, polymorphonuclears 90 per cent Debridement, closure of wound with drainage, application of plaster cast September 4 patient had well-developed gas gangrene, with positive culture, guillotine amputation was performed in the lower third of the thigh October 26, stump was skin-grafted Recovery No gas-bacillus antitoxin

CASE VI—Male, twenty-one years of age Admitted December 13, 1926 Compound fracture of tibia and fibula, from truck accident Leucocytes 12,575, polymorphonuclears 93 per cent Wound debrided, plaster cast applied The next day the swelling and odor suggested gas-bacillus infection, and smear was positive Patient discharged to another hospital, and reported as a recovery

CASE VII—Male, eighteen years of age Admitted July 13, 1927 Compound fracture of right tibia and fibula, from motorcycle accident Amputation a few hours later Temperature and pulse normal until forty hours later, when temperature rose suddenly to 102.4° , and pulse 128 Leg swollen, with foul, putrid odor, no crepitation Smear and culture showed *Welch* bacillus, and later crepitation appeared July 16, second amputation, above knee, July 27, third amputation Recovery No gas-bacillus antitoxin given

CASE VIII—Female, five years of age Admitted August 16, 1927 Compound fracture of upper extremity of left femur, and left fibula and tibia, from being struck by a truck Débridement of wounds, application of Thomas splint Twenty-four hours later temperature was 105° , wounds had swelling, odor and crepitation of gas gangrene, definite *Welch* bacillus grew on culture Smear also positive Fifty cubic centimetres of perfringens antitoxin (not polyvalent) given intravenously, thigh amputated, patient died two hours later, apparently from shock

CASE IX—Male, thirteen years of age Admitted September 8, 1927 Compound fractures of both legs, from street-car accident One hour after admission right leg was amputated, left leg debrided Next day temperature was 102° , patient very restless definite crepitus, no odor Smears from both legs showed *B. welchii* Ten cubic centimetres perfringens antitoxin given intravenously Second amputation next day, patient apparently died from shock

CASE X—Male, thirty years of age Admitted December 15, 1927 Compound

fracture of knee-joint, from gun-shot wound Debrided and splinted Twenty-four hours later temperature was 103.8°, pulse 120, patient had anxious expression, there was bloody drainage, but no gas, and smear was negative The next day there were crepitation and foul odor, and smear and culture were positive, temperature was 102°, and pulse 140 Thirty-five cubic centimeters of "double strength" antitoxin given, and guillotine amputation middle half of thigh performed Temperature then dropped to 97°, pulse 160 One-hundred cubic centimeters of antitoxin given daily for four succeeding days Recovery After the amputation a rabbit was injected with six cubic centimeters from the stump, and killed immediately The *B. welchii* was recovered from the peritoneum Twelve hours after death the rabbit was enormously distended, and gave the characteristic odor of gas-gangrene

CASE XI—Female, twenty-six years of age Admitted February 12, 1928 Compound fracture of right tibia and fibula, from auto accident Amputation immediately, just above knee The next day temperature was 103°, pulse 140, but there was no odor nor bubbles from the wound, and the smear was negative February 14, the smear was positive, although the odor and crepitation were not marked Patient was given fifty cubic centimeters of double strength perfringens antitoxin every twelve hours for three doses, and recovered

CASE XII—Male, sixteen years of age Admitted June 19, 1928 Compound fracture of both legs, from fall in attempting to "swing" freight train Both legs amputated below knees Two days later there were sero-sanguinous discharge from the wounds, and suggestive odor The next day the X-ray showed gas in both stumps, and the culture was positive from the left leg, and negative from the right leg Ten cubic centimeters of polyvalent anaerobic antitoxin administered on admission, and for the two succeeding days, after which fifty cubic centimeters was given daily for three days Later necrosed bone was removed from the stump of the left leg, followed by a third operation for grafting skin After seven months in the hospital the patient was discharged as well

CASE XIII—Male, forty years of age Admitted August 5, 1928 Compound fracture of left fibula and tibia, from motorcycle accident Debrided two hours later Twenty cubic centimeters of polyvalent anaerobic antitoxin given on admission The next day swelling, pain, crepitation and odor were present in the wound, which was treated by multiple, longitudinal incisions, fifty cubic centimeters antitoxin being administered daily for three days Smear and culture the second day were positive Recovery

CASE XIV—Male, twenty-five years of age Admitted August 5, 1928 Compound fracture of both legs, from automobile accident Wounds cleaned with iodine, Dakin treatment instituted, plaster cast applied Two days later positive culture from left leg, treated by multiple longitudinal incisions August 6, seventy cubic centimeters of polyvalent antitoxin administered, August 7, fifty cubic centimeters, August 8, patient died

CASE XV—Male, twenty years of age Admitted October 14, 1928 Gun-shot compound fracture of right ulna and radius Twenty-four hours later odor, crepitation and bubbles of gas appeared, although culture was negative October 16, amputation Fifty cubic centimeters of polyvalent antitoxin given October 15, 16, and 17, October 19, patient died

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DISCUSSION ON FRACTURES

DISCUSSION · DR FREDERIC W BANCROFT, of New York City, said that usually trauma is a very big factor in the development of gas gangrene, but he could report three cases of gas gangrene that occurred in a Municipal Hospital of New York through simple hypodermic injection. Two were treated by an ambulance surgeon and developed gas gangrene with amputation of the arm and death, another one was possibly treated by an outside doctor when the ambulance was sent for, and came into the hospital and developed gas gangrene.

With three such dire complications from hypodermic injections, it would seem advisable to warn the hospitals to inspect their hospital bags to see that their hypodermic solutions are kept sterile. Oddly enough it was a solution of digitalis that was responsible for two of the above cases.

DR KELLOGG SPEED, of Chicago, Ill., said that during the war in 1916 while working in the No. 18 General Hospital, B. E. F. France, Davis of Chicago first made these discoveries about the finding of gas bubbles in the X-ray examination of incipient stages of gas gangrene.

Sometime later the speaker treated and reported a series of cases thus infected by a method of muscle group excision. That saves amputation. One may have to take off a whole group of muscles, such as the extensor groups in the arms or legs because the infection spreads through and along the fascial planes, through the muscle itself not via the lymphatics in the early stages. It does not spread by the blood stream in the early stages. Consequently, if the diagnosis is made early the area traumatized with resulting gas infection, the soft parts which were penetrated, involving only a certain portion of the limb, one or two muscles, may be completely removed, or the area of infection may be completely removed simply by taking out that muscle from origin to insertion and leaving the wound wide open and treating it with the Carrel-Dakin method.

DR URBAN MAES, of New Orleans, La., remarked that Doctor Boland had referred to some work done by Doctor Gage in the speaker's service in New Orleans. He would supplement that by recounting several things that he followed in regard to the prophylaxis of gas gangrene.

A very interesting observation has been made—it has a seasonal incidence in the South. It occurred only at a certain time of the year in people who were wearing woolen clothing at the time they were injured. In the summer, when linen clothes are worn, he had never seen a patient afflicted with gas gangrene who was hurt while he was dressed in linens, always it has been woolen clothing.

He wished also to record in line with what Doctor Bancroft had said, the fact that he had lost two patients from infection such as the type he speaks of, one from a hypodermic injection and another from an infected burn in which the blister broke and the patient was between woolen blankets. In both instances he cultured the wool from the blankets and in both instances recovered the gas bacillus.

It is interesting to bring out the fact that prophylaxis, which is the only

DISCUSSION

safe thing to consider, has largely to do with the matter of contamination with wool in the form of clothing or blankets or other such commodities

DR HENRY H M LYLE, of New York City, said that in 1916 he reported a case of general gas gangrene without local manifestations. A French soldier was wounded in the thigh by a shell fragment. The fragment could not be found in the wound. The wound was treated by the Carrel method and remained sterile. X-ray examination of the upper thigh and lower abdomen showed no shell fragment. It was then assumed that the fragment had been extracted at the dressing station or had fallen out during transportation. On the third day the patient developed symptoms of generalized gas gangrene and he died on the afternoon of the fifth day. At autopsy the following conditions were found: A perforating wound of the left thigh, a penetrating wound of the right femoral vein, migration of a shell fragment to the right ventricle of the heart. Generalized gas bacillus infection. No local infection of the wound. The shell fragment when found in the ventricle had attached to it a portion of the uniform which was undoubtedly the source of the infection. The cardiac muscle was riddled with gas bubbles.

DR SAMUEL C PLUMMER, of Chicago, Ill., stressed the point in diagnosis, that the sense of smell is one that surgeons do not use very much in making diagnoses, but it can be used to great advantage in the diagnosis of gas gangrene. The number of these cases which one sees in civil practice is very small, but a short time before the war he had two cases within a few months of each other. The first of these cases was a compound fracture of the thigh with severe injury to the soft parts. This patient died after an amputation of the hip. The next one was a crushing injury of the upper arm. The arm was practically amputated by the accident. A trimming up was done and the stump left wide open and treated with a wet dressing. On the second day the speaker noticed an odor which was familiar to him from the previous case of gas gangrene. The ends of the crushed muscles which remained were partly devitalized. There was a dark, rather disagreeable color and the odor was that of rotting meat. A smear taken at once showed the presence of the Welch bacillus. An amputation was done promptly only about two inches above the amputation which was already there. This brought them into good, live tissues with good circulation and the man never developed any further symptoms of gas gangrene. He suggested where one has cases of injuries where gas gangrene is likely to occur that one does not overlook the sense of smell in making an early diagnosis.

DR ASTLEY P C ASHHURST, of Philadelphia, confirmed what Doctor Plummer had said about the sense of smell. It is a good thing when you know what the smell of gas gangrene is like. It smells somewhat like a mouse.

During the second battle of the Marne he was in the American Ambulance in Paris. Patients had been coming in so fast and the staff was so small that the patients had accumulated in great numbers. It became his habit

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whenever he got a spare moment between operations to wander around the corridors and smell the patients. Those that smelled like mice he operated on right away because they had gas gangrene. The rest of them could wait awhile.

One more point. When he was a student his father lectured to his students on surgery of all kinds. He described eloquently the *Erysipèle bronzé* of Velpeau, but the speaker had to wait twenty years before he saw a case, though he knew that it must exist because his father had described it. Over in France with the French army, in the early part of the war, he operated on a patient with a compound fracture of the femur, and it was there that he saw the *Erysipèle bronzé* of Velpeau. There were no blisters but it was an erysipelas nevertheless. The disease was in the skin, and perhaps in the subcutaneous tissues a little bit. There was a distinct raised margin next the surrounding unaffected tissues. Under conservative treatment the patient recovered.

In his service at the Episcopal Hospital of Philadelphia a few years ago was a young woman with a compound fracture of the upper extremity. She developed gas gangrene, and along with it the typical bronzed erysipelas of Velpeau. The limb was so rotten that amputation was required. She recovered. That was the only manifestation of gas gangrene of that type he had ever seen in civil life.

Formerly these clinical states were classified as separate diseases, but it is much simpler not to divide them, but to class them all as gas gangrene, whether they be the acute mephitic gangrene of bone of Liddell, or the acute purulent œdema of Pirogoff, or the bronzed erysipelas of Velpeau.

TUBERCULOSIS OF THE PERITONEUM

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IN THE last thirty years we have learned much about tuberculosis, its cause, method of transmission and prevention. Three decades ago, 200 deaths each year out of each 100,000 persons were caused by tuberculosis, today the number is less than half that. However tuberculosis is a great economic burden, often, it causes a loss of years of health, and although the death rate has been checked, nearly as many persons as ever have the disease in some form. Besides tuberculosis in human beings, we gradually have learned of the bovine type and its methods of transmission to man through milk. Thus, tuberculosis of the bovine type, which represents at least 25 per cent of the tuberculosis of children, is now found on farms, and in small towns and villages. In such places, frequently, there is no opportunity to secure pasteurized milk from tested, tuberculosis-free dairy herds. We also have learned of avian tuberculosis, and recently the veterinarians have shown that most tuberculosis in hogs is now classified as of the avian type. Only a few cases of avian tuberculosis have been seen in the human being. When it does occur, it most frequently affects the spleen and liver.

It is only through education of the public, by which it has been instructed in the development, transmission, and prevention of disease, that the medical profession has been enabled to control many diseases. Without this teaching of the public it would be impossible to put into effect the great amount of knowledge that is now possessed concerning preventable disease.

In England and in Scotland greater attention has been paid to the effect of bovine tuberculosis on the human being, and their statistics, I believe, are better than ours. Tuberculosis of the tonsils is often of the bovine type, and also tuberculosis of the lymph nodes, especially of the cervical region. Tuberculosis of the appendix, and of the glands of the intestinal mesentery, may be foci for peritoneal tuberculosis.

From thirty to forty years ago the great surgical pathologist, Christian Fenger, did much to educate the medical profession concerning varieties of tuberculosis that are amenable to surgical treatment, and our great clinical professor of surgery, the late John B. Murphy, did much to advance information concerning peritoneal tuberculosis. Hyperplastic tuberculosis, with nodular masses involving the interior of the intestine, which often produces symptoms due to incomplete obstruction, is but rarely the cause of abdominal tuberculosis of the peritoneal type in which there are ascites and adhesions. Tuberculous peritonitis is nearly always, then, an unmixed infection. It may come from the appendix, and if so, the appendix is closed off from the lumen of the cæcum by a stricture. Then, the appendix may become perforated, and its caseating content may produce a multitude of tubercles.

which are confluent near the source of infection. A tuberculous gland in the mesentery just beneath the peritoneum may become liquefied and, finally, may burst through the peritoneum, infecting the peritoneal cavity. This causes in the immediate vicinity of the focus, a confluent tuberculous mass which becomes less dense in areas further away from the point of rupture. In the early stage there is some pain, or at least some soreness, in the abdomen, this is before enough free fluid has collected to stop the rubbing of the tubercle on the peritoneum. The parietal layer of the peritoneum is sensitive to the rubbing of the tuberculous masses. When free fluid forms, as in pleurisy, pain is relieved. The abdomen increases in size, for there may be considerable distention with gas, and then, the serous, ascitic fluid accumulates.

Involvement of the pelvis in women is caused by tuberculosis of the oviduct. These tubes, lined with mucous membrane, if once affected will remain tuberculous until the tube is removed or is destroyed by the disease.

It was early noted that serous peritonitis, by repeated operations became converted into plastic peritonitis, and ultimately this plastic peritonitis sealed in the focal areas of disease. The trouble might be caused by a liquefied gland or, more commonly, by the oviduct, because tuberculosis is the only infection of the oviduct in which the fimbriated end is not closed. Caseating content escapes from the oviduct constantly until plastic peritonitis seals in the tubes. Today the effort is made to remove immediately such tubes and to enucleate the medial end within the muscular wall, at the cornu of the uterus. Thus, the tubes are removed *in toto*, down to the uterine mucous membrane, otherwise small tuberculous abscesses form in the muscular tissue at the cornu of the uterus. Reports of necropsies show that more than twice as many males as females are affected with tuberculous peritonitis, but probably three times as many females as males are operated on for this condition. In the last two years, 409 cases of tuberculosis of the peritoneum were seen at the clinic, 171 were treated surgically and 238 medically.

Tuberculosis of the interior of the uterus is rare. In girls, before puberty, tuberculous metritis may develop, and if it does the girls never menstruate. The internal uterine os may become closed, and the patients, who never menstruated, may be seen between thirty and forty years of age with pyometria. The liquefied uterine content is of thin, tuberculous material, and only the outer shell of the uterus remains.

It is most unfortunate indeed that of the young women who have had tuberculous oviducts with ascites, many have had both ovaries removed at the time the tubes were removed. Then, all the nervous changes that are so unfortunate ensue from such surgical procedures, and often the lives of the patients are practically ruined for a number of years. There is no more need of removing the ovary in tuberculosis of the fallopian tubes than there is of castrating the male in case of tuberculous epididymitis. Very rarely, castration of man or woman may be necessitated by injury to the ovary or testis by pressure necrosis, but seldom indeed is it necessary to remove these

important structures. In the later stages of tuberculosis of the oviducts the pathologic tissue may be felt in the pelvis by manual examination. The structures in the lower part of the pelvis often are fixed by the plastic adhesions following the ascites. In spite of the fixation, operation should be performed. By locating the fundus, one can follow out the tubes in the dissection, the intestinal adhesions can be separated, and a sufficient area of the tube can be exposed to permit its enucleation being started. Removal of the tuberculous tubes is all that needs to be done to cure the abdominal tuberculous peritonitis.

Just as MacCarty showed that approximately one in 225 chronic appendices removed is cancerous at the tip, so Margaret Warwick found, in a study of percentages of tuberculosis of the appendix, that 1 per cent of them was tuberculous. Many physicians have come to believe that nature does about as well as intervention for these cases. They recommend good care, fresh air, proper food, and sunlight as medical or hygienic measures. Ochsner claimed that he saw about 50 per cent of patients cured by medical care and Allchin showed that 50 per cent of patients were cured either by medical treatment or with very little care of any kind. Sorgo and Fritz recorded a number of cases, watched for a considerable period, in which ether anesthesia given for half an hour to an hour, at repeated intervals seemed to have given great benefit. Rost, in 1920, reported eight cases in which treatment was given by injection of oxygen into the peritoneal cavity after the fluid had been removed. Many cases of this sort have been reported. Most of these injections of oxygen or of air probably result in the change from a serous to a plastic type of peritonitis, resulting in the development of adhesions. In the treatment following surgical operation, ultraviolet light or sunlight applied under proper precautions, care to build up bodily resistance, and increase in the dosage of sunlight after Rollier's method are commonly employed. Such methods, of course, are merely to aid the body, in a natural way, to care for itself.

About 50 per cent of the cases of peritoneal tuberculosis occur in the two decades of life between twenty and forty. It is of little avail to operate on children a year or two old. They usually die of the disease, but they offer an opportunity for the use of adjunct medical treatment. It is generally considered that many patients receive benefit from roentgen ray, which now is used widely in the treatment of tuberculous glands or of tuberculous areas in other regions, even when the tuberculosis apparently is not exceedingly destructive.

I wish to reiterate that, after many years of observation of tuberculous peritonitis in women, it has been shown that the majority of such cases arise from infection of the mucous membrane lining the oviducts. When the foci of the disease are eradicated, the patients may rapidly recover, and are less likely to suffer later from trouble in the lungs, although they may have quiescent disease there. In the cases in which treatment is by other methods, and the involved mucous membrane is not removed, tuberculosis often

develops later in some other region, such as the lungs, and death results. When there is a fixed mass in the pelvis, probably tuberculous, with or without ascites, I would advise exploration even if the disease apparently is subsiding. If tuberculous tubes are found, they should be enucleated. It is inadvisable to separate extensive adhesions, because adhesions from tuberculosis of this form outside of the lumen of the bowel rarely are obstructive. With the utmost care, the surgeon should open a way through the adhesions, until the tube can be reached, then it can be enucleated readily. If, by accident, a hole should be torn in the intestine it should be closed by suture as well as possible and then the nearest adjacent bit of omentum (seldom to be obtained) should be placed against it and held there by sutures. If omentum is not obtainable, the injured area of the intestine may be covered with adjacent mesentery or intestine, so as more effectually to close the opening, then tincture of iodine should be applied and the abdomen should be closed without drainage.

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CHRONIC, NON-SPECIFIC ENLARGEMENT OF THE MESENTERIC LYMPH NODES, AS RELATED TO SURGERY

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ENLARGEMENTS of the mesenteric lymph nodes have been observed for a long time especially those due to tuberculosis, but surgical attention has only recently been directed to chronic non-specific hyperplasia—a common and definite condition deserving careful consideration. It is met with quite frequently in laparotomies upon children and especially young adults (about 13 per cent according to Guleke,¹¹) although found often enough in those of middle age. Most surgeons, however, are not familiar with it and seldom consider it, either before or during operations. Even when detected it is not often properly evaluated, although it may represent the only discoverable lesion.

Probably the first papers dealing with the surgical aspects of the subject were written by Carson⁶ of London, in 1918, followed by Struthers,²³ of Edinburgh in 1921, but both of them confused the tuberculous with the non-tuberculous form, as have all other English and most American authors. As far as I am aware my own contribution,⁹ in 1923 was the first in this country dealing with the surgical significance of the chronic form of the disease,

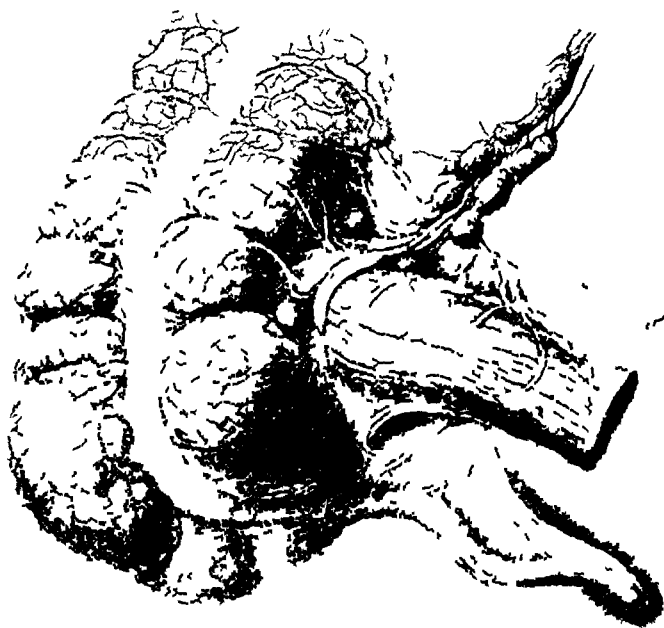


FIG 1.—Lymph nodes of ileocecal region (appendix) (From Morris *Anatomy*, eighth edition, p 771)

although Wilensky²⁵ published a paper in 1920 dealing with the acute, inflammatory form limited to the ileocecal angle.

Three forms of enlargement of the mesenteric glands may be recognized (1) The chronic, hyperplastic, non-specific, non-inflammatory, (2) the acute and chronic inflammatory, and (3) the specific (tuberculous, etc). Undoubtedly the whole question has been much obscured by confusing these

different kinds, especially the hyperplastic with the tuberculous. This tendency has been universal in England (Carson, Struthers, Braethwaite,⁴ etc.) and almost so in America (Wilensky, Head,¹² Bell,³ etc.), while the Germans (Guleke,¹¹ Pribram,¹⁸ Heusser¹³), have clearly recognized the distinction and proved it by animal inoculation and otherwise.

Anatomy—The mesentery of the small intestine, with which we are principally concerned, contains from 125 to 200 lymph nodes, while that of the colon has comparatively few, the appendix having a small group of its own within the ileocaecal angle, which is not closely connected with the others (Fig 1).

Normally these nodes are too small to attract attention. Those nearest the mesenteric root are larger than those nearer the bowel. They are arranged in three groups, one close to the bowel, one near the root of the mesentery and an intermediate set (Fig 2). They are made up of lymphoid elements, lymphatic capillaries, blood vessels, nerves, and supporting elements. A network of lymphatics runs to and around them, transporting lymph from the intestine, and they are well supplied with blood vessels.

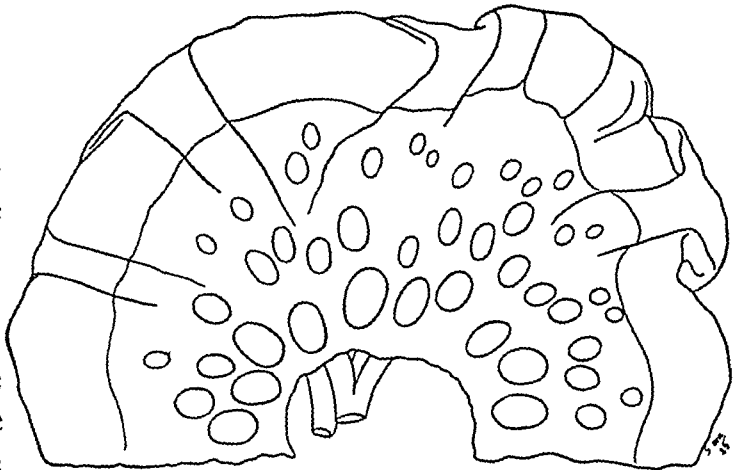


FIG 2—Schematic distribution of enlarged lymph nodes in mesentery of small intestine

There is likewise in the mesentery an extensive network of fibres of the autonomous nervous system (Figs 3 and 4),

anastomosing freely with each other and sending numerous filaments to the glands, the lymphatics and the intestine (plexuses of Auerbach and Meissner.) This network of nerves forms a part of the bewildering maze of sympathetic and arasympathetic fibres which, through the intermediation of ganglia, plexuses and numberless anastomoses, connect the abdominal organs with each other and with the cerebro-spinal system through the spinal ganglia (Fig 3), thus aiding in regulating and synchronizing the various vegetative activities. It is the action of the enlarged mesenteric glands upon these autonomous nerves with which this paper is largely concerned.

Pathology—In chronic, non-specific hyperplasia the enlarged glands are scattered through the mesentery of the small intestine principally near its root and toward its distal portion (Fig 2), and, when too much fat is not present, are easily recognized as soft, flattened, round or oval, somewhat reddish-colored bodies, elevated slightly above the surface and ranging in size from a small pea to a bean and occasionally larger. They may be few or numerous. The peritoneum is unaltered, as is usually the mesentery itself,

although the latter is occasionally thickened or shows evidences of sclerotic changes (Pribram)

These glands almost always contain no microorganisms and show no pathologic changes except simple hyperplasia (Fig 5) Although the mesenteric lymphatics usually are free from apparent inflammatory changes, obliterating processes sometimes exist, thus accounting for the moderate amount of ascites often observed (Pribram)

Etiology—The trouble is found most frequently in the young, adults as well as children, occurring with decreasing frequency as middle life is attained Those affected with it are apt to be of the neurotic type, the reasons for which will be discussed later There are few grounds for thinking it is due to a lymphatic constitution (Heusser), to habitual constipation (Pribram), or to chronic appendicitis (Carson) Although appendicitis is found in many instances (one-half the cases according to Bagg¹) it is probably a coincidence, the lymphatic system of the appendix being separate and confined to the ileo-cæcal angle (Fig 1), while the glandular affec-

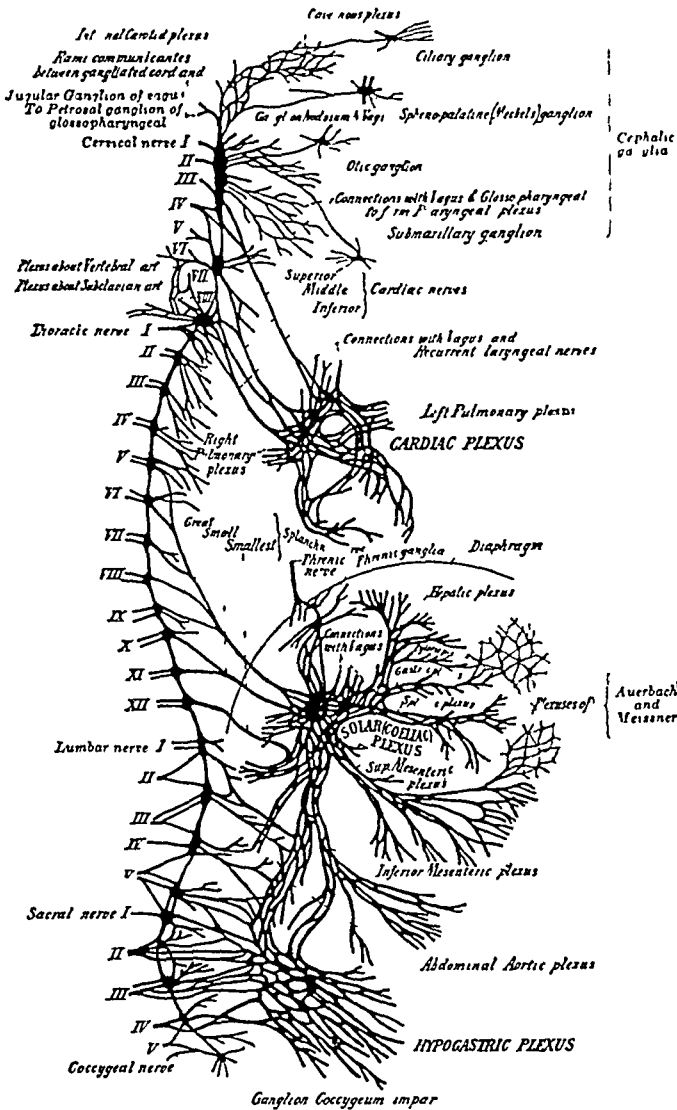


FIG 3—Sympathetic nervous system showing communications with cerebrospinal system (From Morris' *Anatomy*, fifth edition, p 1028)

tion under consideration is much more extensive Melman¹⁵ states that it often is found in connection with rachitis

Most authors accept tuberculosis as the cause, as suggested by Carson While this view undoubtedly is sometimes correct, there are reasons against it, the principal one being that evidences of tuberculosis are not often found in the glands themselves, either microscopically or by animal inoculation, the former method being, perhaps, almost if not quite as reliable as the latter (Fig 6) Heusser, for instance, in twenty-five guinea-pig inoculations failed

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to demonstrate it in a single instance; and he adds that he has been able to find it only when the glands are hyaline, caseated or calcified—in other words, in those which are manifestly tuberculous to the naked eye

During the last eight years I have observed 119 cases—thirty-one males and eighty-eight females. The greatest number, forty-seven, were between

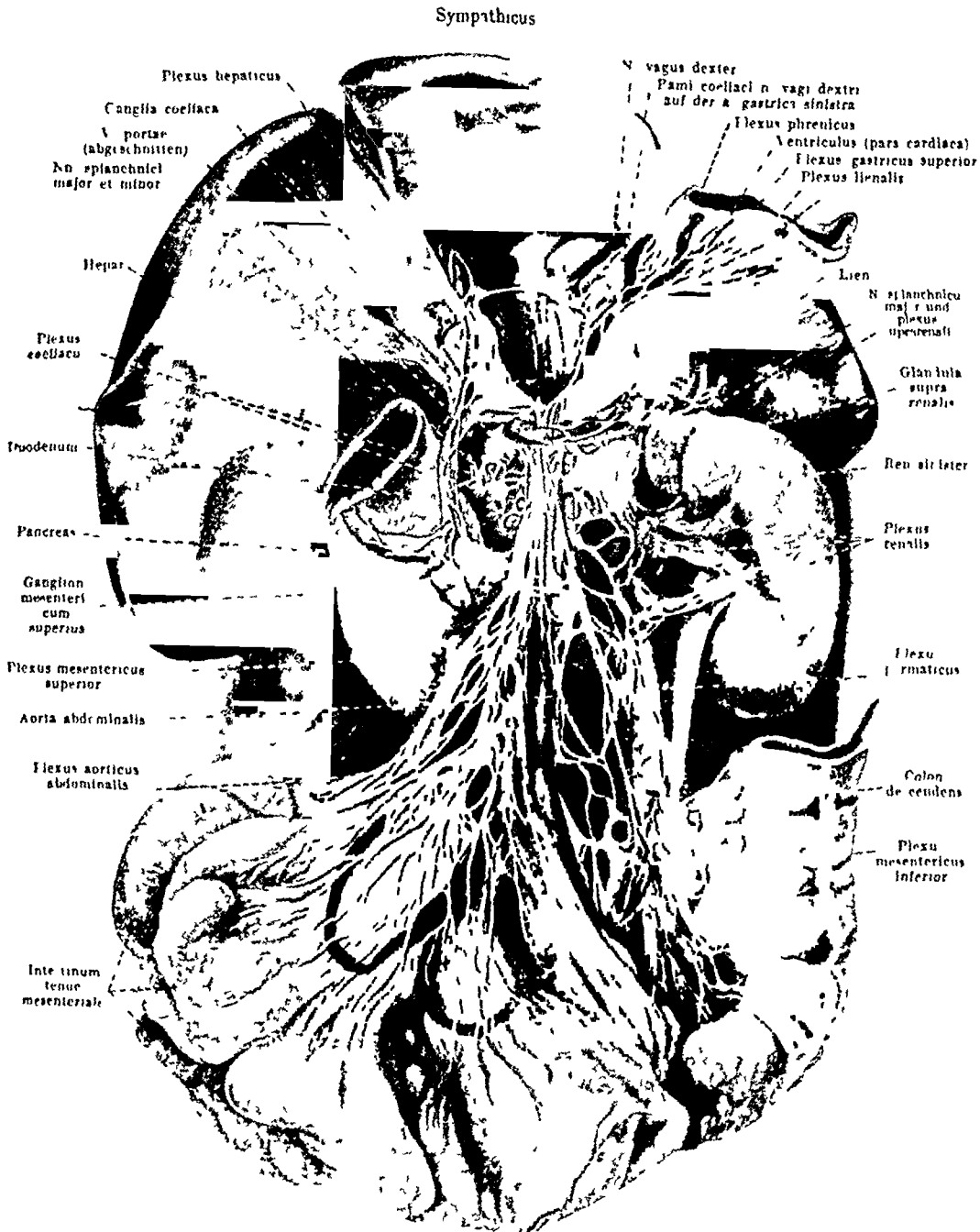


FIG 4—Abdominal sympathetic system (From article by N Guleke, *Archiv Klin. Chir.*, B 133, p 529)

twenty and thirty years of age inclusive, those above thirty numbering twenty-eight, and those between fifteen and nineteen amounting to twenty-three. Seven cases were over forty, fifteen under fifteen and eight under ten. The oldest was fifty and the youngest four. Hence it is manifest that the disease occurred most frequently between twenty and thirty years, although it

is common enough before and after those ages. It can hardly be termed a children's disease, as has been claimed, although it belongs to the first half of life.

In ninety-two cases the glands were very numerous and in twenty-seven they were moderate in number. In eight cases they were manifestly tuberculous to the naked eye (calcification, caseation, etc.)

In about fifty cases, glands removed during operations were reported upon pathologically. Seven of these were positive for tuberculosis and the rest negative (simple hyperplasia), the positive findings occurring with a single exception where tuberculosis could also be easily detected macroscopically.

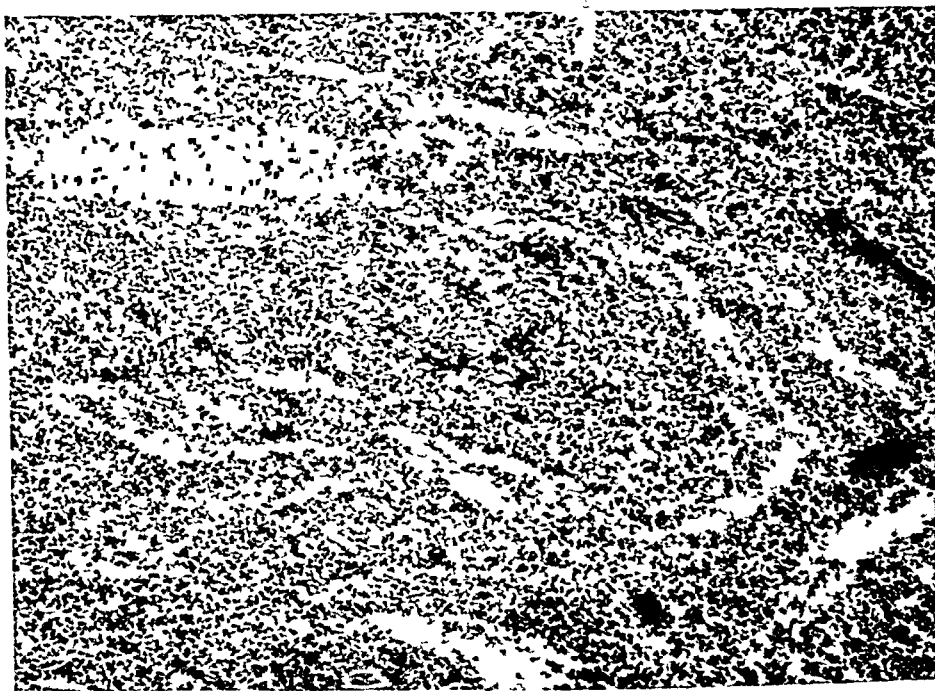


FIG. 5.—Chronic non-specific hyperplasia of a mesenteric lymph node.

pically, thus agreeing with the statements of Heusser previously mentioned. There were, along with the histological examinations, some twenty guinea-pig inoculations, but for various reasons only about half of them could be utilized. Among these, evidences of tuberculosis were found in four, but here again the inoculations were done merely to verify a diagnosis previously made by inspection. In seventeen instances enough fluid to attract immediate attention was found in the abdomen, always when the glands were numerous.

Among various reasons for excluding tuberculosis as a cause are the self-limited character of the disease, the absence of tuberculosis elsewhere, the uniform similarity of the nodes, without caseation or calcification, and the failure of the von Pirquet test (Bunning⁵).

The advocates of the tuberculosis theory, however, contend that in the early stages the bacilli may be too few to find, or have died out completely, or the trouble may be due to toxins alone, but these arguments seem inade-

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quate in the face of the negative laboratory findings and the failure to demonstrate the disease in the bowel or elsewhere

In fact, when demonstrable lesions of the digestive tract do occur, as in appendicitis, colitis, cancer, gastric and duodenal ulcer, etc., glandular enlargement is not a prominent feature, and when it is seen it is strictly regional and not widely distributed, as is the affection under discussion. In 300 cases of tuberculosis of the bowel, Winkler observed glandular enlargement only twice!

Head¹² and others advance the bovine bacillus as the cause but the same arguments are valid against this as in the case of the ordinary germ,



FIG. 6—Tuberculosis of a mesenteric lymph node, showing necrotic areas and giant cells

and in addition Shrota, of Japan, has reported twenty-four cases in which no milk had been consumed

Because the mesenteric glands receive lymph from the intestines, it has been universally assumed that the latter are the source of the irritative material causing hyperplasia. While this theory may be true, at least partially, there are a number of objections to it

1 The larger glands usually are not found near the bowel, but more toward the root of the mesentery. To explain this it has been assumed, without proof, that the deeper glands possess a greater susceptibility, or that the lymphatics lead more directly to them

2 In the great majority of instances no causative bowel lesions can be found, in fact, Heusser wishes to limit non-specific hyperplasia to such cases. Some try to explain this (Pribram, Guleke, Pick) by the hypothesis that the lesions are very small, or have disappeared, while others (Pribram) affirm

that bacteria may be absorbed through the normal intestinal walls, but if this is true they should be detected more frequently in the hyperplastic nodes. Wilensky thinks that Peyer's patches may be the source of infection, likening them to the tonsils in this regard although this would hardly account for the enlarged glands situated high up in the mesentery. Still others assert that the irritating agent is a toxin only pointing to the fact that microorganisms are seldom if ever found in the enlarged nodes. Heusser suggests intestinal parasites as an origin for such a toxin (oxyuris, round-worms, etc.), and in this he is supported by Brunning, Loewen, Reinhardt, Hueck and Noack, and others. While intestinal parasites may be sufficiently common in Germany to lend credence to this view, although Guleke¹¹ found neither parasites or their ova in 50 per cent of his cases, it is certainly not true of this country, in fact I have never encountered them at all, and they are seldom mentioned by other American observers. In England, Carson saw them in but four out of fifty patients. In addition, if such potent toxins actually exist, it seems they should produce more evident bowel symptoms, to say nothing of their effect upon the liver and the kidneys.

3 If the trouble is really due to the *continuous* absorption of irritating material from the bowel, the glands would scarcely remain so uniform in size and appearance but some of them, at least, would eventually become large and hard and show evidences of inflammatory changes. One would also suppose that the greatest accumulation of enlarged glands would be in the immediate neighborhood of some assumed lesion, instead of the uniform distribution which is usually found.

The vascular origin of glandular hyperplasia has seldom been considered in spite of the fact that various diseases, presumably through the blood, cause enlargement of glands all over the body, with a tendency to select certain susceptible groups—for instance, syphilis, Hodgkin's disease, lymphatic leukemia, glandular fever, etc.

My own case histories indicate that influenza frequently precedes mesenteric lymphadenitis. This also is mentioned by Melman and Pribram, while Wilensky says that enlargement of glands elsewhere is often encountered and Baumgarten² refers to acute glandular fever as an accompaniment. Colmers,⁷ Edelman,⁸ and Schmieden²⁰ also mention involvement of the mesenteric glands in *grippe*, the irritation from which may be marked enough to cause a spastic ileus. Hence I am inclined to believe that influenza and allied disturbances are responsible, through the vascular system, for chronic hyperplasia of the mesenteric glands, in many instances at least. This theory agrees with the absence of bacteria and of intestinal lesions, with the uniformity in size and appearance of the nodes, with the extent and manner of their distribution, and with the self-limited character of the disease.

Symptoms—When symptoms are present, which is not always, they are often indefinite and confusing because of their functional character and dependence upon the nervous irritation of various abdominal organs. There

are, nevertheless, certain outstanding features that deserve consideration and which often permit of at least a tentative diagnosis *

1 *Pain, tenderness and rigidity*, although usually present, are seldom very pronounced. They occur around the centre of the abdomen with a strong tendency toward the right iliac fossa, following, in general, the attachment of the mesentery. There also is often a nervous irritability of the muscles rendering deep palpation difficult.

Frequently the pain is colicky in character, due to spasm of the bowel, as pointed out by Carson. I have noted a striking spastic irritability of the bowel many times during operation, and believe that it accounts for some of the indefinite colics so often encountered in children. Carson states that it may cause intussusception, and has actually seen this condition develop in the course of a laparotomy. It may even result in an actual ileus in acute cases (Edelman, Colmers, Schmieden).

2 *Various dysfunctions of the digestive tract* are frequent, such as constipation, diarrhoea, flatulence, indigestion, anorexia, etc., resulting in loss of weight and energy and depending upon irritative disturbances of the autonomous nervous system. Pylorospasm is frequent, together with hepatic symptoms pointing to spasm of the sphincter of Oddi, due, according to Keppler and Erkes¹⁴ to involvement of the superior mesenteric glands. The constipation may be accounted for by spasm of the rectosigmoid sphincter (Carson).

3 *A rise in temperature* is often present, seldom exceeding one or two degrees. This may persist for a long time, and when, in a young individual, it cannot be accounted for otherwise, a suspicion of mesenteric lymphadenitis may be entertained, especially in the presence of other characteristic abdominal symptoms.

4 *A "neurotic temperament"* is noted so frequently that it probably amounts to more than a coincidence. While several explanations for this might be offered, I believe the real cause is an irritation of autonomous nerve filaments by the lymphatic elements in the mesentery. As Guleke puts it, it is common knowledge that caseous and calcified lymph nodes can cause irritation of nerves and we are justified in assuming that simple hyperplasia may do likewise. This nerve irritation affects the adjacent intestines and is widely reflected throughout the abdomen by way of the coeliac plexus (Vorschutz²¹). It is also carried to the cerebrospinal nervous system through the spinal ganglia, causing irritability of the abdominal muscles by way of the spinal nerves, and it may also account for the general neurotic condition through disturbances of the higher nerve centres (Fig 3).

That similar phenomena occur with other pathologic conditions is a matter of common observation, for instance in ulcer of the stomach, chronic appendicitis, mucous colitis, etc., and it also is suggestive that a reverse process is frequently met with, in which psychic disturbances give rise to inter-

* The cooperation of Dr J. N. Hall has been of much value in the symptomatic study of many of my cases.

nal functional disorders, notably of the stomach, intestines and ductless glands

Diagnosis—A definite diagnosis is difficult before opening the abdomen owing to the similarity of the symptoms to those of other abdominal lesions. Nevertheless, a "good guess" may often be hazarded, although it would be unwise to place too much reliance upon it for fear of overlooking some important lesion, especially a pathologic appendix.

As diagnostic signs of more or less value, Steinberg²² gives two tender points on deep pressure, one in the right hypochondriac region, easily confused with the appendix, and the other to the left of and a little above the umbilicus, opposite the second lumbar vertebra. Payr calls attention to a tender area between McBurney's point and the navel, to which he attaches importance.

In attempting to differentiate between simple and tuberculous lymphadenitis, tuberculin has been recommended (Head,¹² Heusser,¹³ Brunning⁵), but its value is questionable except when the outcome is negative. Heusser affirms that a diagnosis of tuberculosis is hardly justifiable unless a tumor can be felt or calcified glands demonstrated by the X-ray.

In general it may be said that, confronted by a child or young adult of a nervous temperament, with more or less indefinite abdominal symptoms resembling those of chronic appendicitis, but less pronounced, one is justified in considering non-specific hyperplasia of the mesenteric lymph nodes, especially if the symptoms are long-continued, constant, and devoid of definite attacks, and if there is loss of strength and energy and a slight rise in temperature.

Prognosis—Although mesenteric lymphadenitis does not seem to be a serious disease, it can be a very disturbing one. Especially in children, it may lead to nervous troubles and various internal dysfunctions having a decided bearing upon mental and physical development.

Unquestionably the trouble is self-limited, because it is found so frequently in the young and so seldom in later life, and it seems to leave no definite pathology behind it. At present we have no means of estimating how long its course actually is. Although we know that the symptoms often vanish quite rapidly after a laparotomy, as emphasized by Carson, Braethwaite, Guleke and others, they by no means always do so, thus adding one more to the numerous causes for "unsuccessful" operations for appendicitis.

Treatment—Following laparotomy, which usually precedes a diagnosis, if the symptoms do not promptly disappear, further treatment should be instigated. This may consist of

- 1 Hygienic measures, including proper diet, open-air exercise, cod-liver oil, etc., as indicated. Tuberculin is of course useless in simple hyperplasia, and also in the tuberculous form, according to Braethwaite.⁴

- 2 Heliotherapy and other forms of radiation, such as ultraviolet light (Head¹²). Bagg¹ says that the X-ray is of no service, and if its use is decided upon it should be employed with caution.

The appendix should always be removed, among other reasons because

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there will always arise a suspicion that subsequent symptoms may be due to its presence

Pribram very properly emphasizes the necessity for adequate incisions, permitting careful inspection, for otherwise the disease is apt to be overlooked

RÉSUMÉ

1 Chronic non-specific enlargement of the mesenteric lymph nodes is a distinct affection occurring in the first half of life, especially between the ages of twenty and thirty, although common enough before and after those years

2 In spite of its frequency, comparatively little attention has been called to it and its surgical significance is not often recognized during and after abdominal operations

3 The hyperplastic glands, perhaps the size of a large pea, can be seen and felt, often in profusion, in the mesentery of the small intestine, beneath the unaltered peritoneum. There are usually no signs of inflammation, although fluid is often present in the peritoneal cavity

4 The irritating agent is assumed by all writers to proceed from the bowel, although intestinal lesions can seldom if ever be demonstrated and, *vice versa* when ulcerations of the bowel exist, enlargement of the mesenteric glands is uncommon. Among possible causes are intestinal parasites and influenza (vascular origin), but the majority of writers favor tuberculosis, although evidences of the disease can seldom be found in the glands, the intestines, or elsewhere

5 The symptoms, resembling those of chronic appendicitis but more diffuse and less pronounced, are mainly pain, tenderness and rigidity, with perhaps a slight rise in temperature. Various local and general symptoms, such as colics, dysfunctions of the digestive tract, pyloric spasm, spasticity of the abdominal muscles, nervous irritability, etc., probably arise reflexly from irritation of the autonomous mesenteric nerves by the enlarged glands

6 A definite pre-operative diagnosis should be made with caution, for fear of overlooking some lesion requiring operative attention, such as appendicitis

7 The treatment includes hygienic measures and heliotherapy. Sometimes, but not always a laparotomy alone leads to rapid recovery. The appendix should always be removed, if for no other reason than because of the tendency to ascribe all subsequent symptoms to its presence

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DISCUSSION DR DEAN LEWIS, of Baltimore, Md, asked Doctor Freeman if the blood of these patients agglutinated the bacillus melitensis There is a possibility, he believed, that in some of these cases Malta fever may have been the disease from which these patients suffered Physicians are recognizing that undulant fever is more common than was supposed It manifests itself in different ways A case of intermittent hydrops of the knee-joint recently studied at the Hopkins Hospital had undulant fever and the bacillus was grown from both knee-joints This disease should be kept in mind in some of these obscure, indefinite lesions

DR GLORGE J HEUER, of Cincinnati, Ohio, asked Doctor Freeman

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whether he had found any relationship between the condition he had been discussing and the so-called acute glandular fever which occurs sometimes in epidemic and not infrequently in sporadic form. The speaker had operated several times upon such cases under the mistaken diagnosis of acute appendicitis. The patients had presented themselves with fever, nausea and vomiting, and sometimes diarrhoea, and with marked tenderness and muscle spasm over the appendix region. The suggestion of appendicitis had been so strong that he had been unwilling not to operate on them. At operation the peritoneum had been slightly inflamed, with a quantity of clear fluid in the peritoneal cavity, the appendix had appeared normal but the mesenteric lymph nodes had shown very marked enlargement and inflammation.

The question is: What becomes of these enlarged lymph nodes that one finds at operation? Do they subside or do they sometimes remain enlarged and give rise to chronic glandular enlargement as in the cases which Doctor Freeman has cited? His particular question was whether in the past history of his patients Doctor Freeman had obtained a history of acute illnesses which suggest acute glandular fever?

DR HUBERT A. ROYSTER, of Raleigh, N. C., said that he was familiar with the work of Doctor Freeman with respect to mesenteric lymphangitis and his study of the irritable abdomen. He was also familiar with the work of Wilensky who studied this question in children very thoroughly. He had had occasion to review all of these in relation to six cases of this type of infection which he had had in the past few years. In all of these cases the diagnosis of appendicitis was made, save one, in the last one they suspected the lymphangitis on account of the study of the previous ones.

He was satisfied that some of these were due to lymphatic block around the appendix, and the removal of the appendix mechanically releases the block. He was also perfectly satisfied that Doctor Heuer's suspicion was right in regard to the so-called glandular fever, because the last case the speaker had, even after the removal of the appendix, went on with a regular course of the so-called glandular fever. A study of the blood developed the mononucleosis which is characteristic of this infection. All of the cases got well after having the appendix removed. As to the suggestion of Doctor Lewis, there have been a few cases of undulant fever developing in children, showing the signs of mesenteric lymphadenitis.

DR FRANK S. MATHEWS, of New York, recalled a number of cases seen in the last two or three years with large and calcified lymph nodes, which had come with a variety of diagnoses and had in some cases had operations advised under the diagnosis of kidney or gall-stones or chronic appendicitis. Some had already had their appendix removed. One point about these patients with chronic nodes had impressed him, namely, that they had symptoms (chiefly pain) which seemed to depend on the presence of the nodes. They had not been definitely characteristic of either an appendix, gall-bladder or a kidney stone. In two there had been a history of slight hematuria and once a

DISCUSSION

history of jaundice. In two cases, he had removed a fair-sized single calcified node with relief of the symptom of which the patient complained.

DR LEONARD FREEMAN (in closing the discussion) said the question of glandular fever had been taken up quite elaborately by Baumgarten who published it in this country sometime ago in the *Michigan State Medical Journal*, 1925. Personally he did not know much about undulant fever. He had never gotten any history of it, but he stated in his paper that various forms of acute diseases that may occur can cause, through the blood perhaps, enlargement of the mesenteric glands.

As to calcified glands causing symptoms, calcified glands are perhaps always tuberculous. At least one has a right to consider that they have been so. So they would hardly come under this heading. But the point is interesting that calcified glands, as well as other enlarged glands, do cause symptoms and that is one reason one has for considering that these enlarged hyperplastic mesentery glands may also be the cause of the symptoms that seem to go with them.

THE SURGICAL TREATMENT OF BILE TYPHOID CARRIERS

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It is almost trite to state that one of the outstanding accomplishments of preventive medicine was the practical elimination of typhoid fever from the war zone during the late World War. The two reasons for this great triumph in sanitation are first, all individuals engaged in the war zone were immunized by vaccination against typhoid, and secondly, military law and public opinion and cooperation made possible the enforcement of drastic measures necessary to the detection and elimination of the typhoid carrier.

Unfortunately in peace time, with the general public, compulsory vaccination against typhoid, and the early detection and close and constant supervision of the typhoid carrier are exceedingly difficult. For these two reasons typhoid continues to be endemic. According to the Metropolitan Life Insurance Company¹ there occurred in the United States in 1926, 41,377 cases of typhoid with 7614 deaths and in 1927, 34,411 new cases with 6525 deaths. Garbat² states that, in the period of 1920 and 1921, about 150,000 typhoid cases were reported in the United States with a production of approximately 7500 carriers. There are still many hospitals in this country where the typhoid convalescent is discharged to the community without proper steps being taken to determine the question as to whether or not he is a carrier.

The study of the typhoid carrier may be said to have been initiated by Robert Koch³ who in 1902 first called attention to the typhoid patient or convalescent as the most serious source of the spread of the disease. Frosch⁴ first proposed the theory that the typhoid bacillus may play a saprophytic role in the intestinal tract over a long period and this hypothesis was confirmed by the bacteriological studies of Drugalski.⁵ He was the first to trace a convalescent to the chronic carrier state. It soon became evident that the carrier spread the bacillus in both urine and feces, and this led to an active study of the best media to be used for the rapid detection of the bacilli in the excreta of typhoid convalescents.

Investigations, both clinical and experimental, point to the gall-bladder as the nidus of the typhoid bacillus both during the disease and long after. Futterer⁶ in 1888 first showed that the bacillus could be isolated from the gall-bladder in fatal cases of the disease. Longcope⁷ took bile cultures as a routine in suspected typhoid deaths at the Pennsylvania Hospital and found the typhoid bacillus regularly in all positive cases. The gall-bladder has been shown to be the nidus of infection in the chronic typhoid carrier state, experimentally produced in the rabbit. Blochstein⁸ first showed that rabbits given intravenous injections of typhoid cultures gave positive cultures of the bacilli

in the gall-bladder weeks after the injection Gay⁹ was able to produce the carrier state in normal rabbits by intravenous injection of typhoid bacilli in 90.6 per cent of the forty-three animals used

The presence of gall-stones in the chronic typhoid carrier, both human and in the experimentally produced state, is an outstanding feature and is significant in that the presence of a porous, foreign body in the gall-bladder makes it next to impossible for the gall-bladder bile to become sterile In the combined twenty-eight cases of Haalands and our series of carriers operated upon, 90 per cent showed gall-stones, some of them as early as three months after the disease Pratt¹⁰ reports a case of gall-stones removed on the eighteenth day of the fever The bacilli may persist for years after the typhoid The writer, when House Surgeon at the Roosevelt Hospital, cultured the stones in a case of gall-bladder disease operated upon by Dr Charles N Dowd Active pure cultures of *B typhosus* were obtained from the centre of all three of the large stones The patient had had typhoid fever thirty-two years previously

The problem of the carrier state in the transmission of infectious diseases has been thoroughly discussed by Sacquépée¹¹ and by Ledingham and Arkwright¹² Gay⁹ summarizes their findings and adds his own wide experience in his discussion of the typhoid carrier in his Monograph on Typhoid Fever The reader is referred to this chapter for a detailed review of the literature to 1918

The most extensive and careful study of the typhoid carrier from the standpoint of the pathogenesis of the carrier state is that of Garbat² published in 1922 This analysis is based upon the study of 164 typhoid cases occurring in the internment camp for German civilian prisoners at Hot Springs, N C, in 1918 Because these patients, cared for in the Military Hospital in Asheville, were under military control it was possible to carry out certain procedures like duodenal intubation and frequent bacteriological examinations, both during convalescence and for weeks afterward that would be next to impossible in a civilian community

Garbat's studies corroborated the work of other investigators that the carrier distributes bacteria either through the urine or the fæces, or both The urine carriers will not be reviewed in this discussion Suffice it to say that the urine carriers clear up much more rapidly and in only about 1 per cent of all typhoid cases does the bacilluria continue for as long as two to three months His study of the fæces carriers is his most important contribution to the problem of typhoid dissemination He demonstrated that there are three distinct types of fæces carriers, according to the nidus of infection (a) liver, (b) gall-bladder, (c) intestine In the first two the bacilli enter the intestine with the bile In the intestinal type the bile passages are free of infection

- Of these 164 typhoid cases thirty-nine, or 21 per cent, showed *B typhosus* in the fæces during convalescence There were in addition fourteen cases in whom duodenal intubation cultures revealed the bacilli after three con-

SURGICAL TREATMENT OF BILE TYPHOID CARRIERS

secutive stool cultures had been proven negative. That is, there were fifty-three, or 32 per cent, of the 164 cases that proved to be carriers for varying periods of time after the temperature had reached normal. Of these, 28 to 29 per cent were temporary carriers while 3 to 4 per cent became permanent carriers. These studies proved beyond question that duodenal intubation culture was a much more reliable method of determining the bile carrier state than stool culture. Garbat showed that stool cultures fail to detect the bacilli in 15 per cent of the carriers.

In the intestinal carriers bile cultures show no typhoid bacilli whereas the stool cultures show a heavy growth. This type of carrier is exceedingly rare. The great majority are bile carriers, and the great majority of the bile carriers are gall-bladder carriers. It is possible to differentiate the intestinal carrier from the bile carrier by duodenal intubation and stool cultures, but it is impossible to differentiate the two types of bile carriers, *i e*, duct or liver or gall-bladder types. It is most important to try to establish the type of faeces carrier during convalescence, *i e*, at the beginning of the carrier state. At this stage the intestinal is readily differentiated from the bile carrier. If the faeces carrier shows on two or three consecutive days an absence of bacilli in the duodenal bile the carrier must be observed as an intestinal carrier and surgery is not indicated as it is in the bile carrier.

It must be again emphasized that the detection and control of typhoid carriers is far more difficult in civil life and in peace times than in a military hospital or under a military régime. The menace of a carrier and the difficulties of dealing with an ignorant and obstinate individual are well portrayed in the fascinating detective story of "Typhoid Mary," published by her discoverer, Dr. George A. Soper.¹³ Typhoid Mary, as a cook, was responsible for ten known outbreaks of typhoid fever. The total number of her known victims was fifty-one. Owing to the fact that only parts of her entire history and whereabouts are known it is probable that the total number of outbreaks for which she is responsible is much larger than the record indicates. Dr. William H. Park¹⁴ states that she is now isolated at the Riverside Hospital in New York City. She has consistently refused to have her gall-bladder removed.

In New York State, not including New York City, the State Department of Health¹⁵ has listed at the present time 204 active typhoid carriers. They are under supervision, are not allowed to engage in any food handling occupation, but they are scattered over the state and are not under military control. Last year alone twenty new carriers were discovered and added to the active list. One of these carriers had had typhoid thirty-seven years previously.

No cure for the bile carrier state by any means other than cholecystectomy and drainage of the common duct has as yet been discovered. Dehler¹⁶ was the first to use surgery in the therapy of the carrier state. In 1907 he performed two cholecystostomies, one was cured the other remained a carrier. Since then isolated cases or small groups of cases have been reported

with varying success Fromme¹⁷ summarized the results of surgery in the treatment of the typhoid carrier state up to 1910

The lack of a more positive stand for surgery in dealing with these unfortunate individuals is chiefly due to two factors (1) Some of the carriers operated upon with cholecystectomy or cholecystostomy have continued to be carriers (2) The operations may have been done by incompetent surgeons in asylums or state institutions with a high mortality—a much higher mortality than is seen in well-equipped and well-manned general hospitals—and there has been created a prejudice against advising surgery Thus in the New York State Department of Health¹⁵ Doctor Roberts says, “We refrain from advising any carrier to have a gall-bladder operation on account of the considerable operative risk involved Carriers, however, who wish to have such an operation performed, may receive treatment at the expense of the State”

A report from the New York State Department of Health, dated April 25, 1929, summarizes the results of gall-bladder operations on typhoid carriers in New York State, exclusive of New York City

Known carriers considered to be cured by operation	14
Known carriers probably cured by operation	2
Known carriers not cured by operation	5
Known carriers who died after operation before results could be determined	5
Other known carriers whose gall-bladders were removed but results not yet determined	3
Carriers discovered after gall-bladder operations	5
Total	34

The following is a report from the New York City Board of Health on Bile Typhoid Carriers operated upon with cholecystectomy and recorded in the New York City Board of Health

“Our present knowledge of these carriers is much too meagre to draw any conclusions We have records of seven cases operated upon for removal of the gall-bladder, to remove the carrier condition Of these seven, three have disappeared from our view, two having absconded and the third is now living in New Jersey, she is one of the cases operated upon by Doctor Whipple The stool findings in our seven cases show as follows

“Carrier No 17—Stools examined after operation show positive, 0, negative, 10, no growth, 1

“Carrier No 111—Stool examinations since operation, 5 positive, 3, negative, 2, no growth, 0

“Carrier No 119—Stool examinations since operation, 3, positive, 1, negative 2, no growth, 0

“Carrier No 401—Stool examinations since operation, 11 positive, 1, negative, 10, no growth, 0

“Carrier No 421—Stool examinations since operation, 7 positive, 0, negative, 7, no growth, 0

“Carrier No 479—Stool examinations since operation, 113, positive, 74, negative, 39, no growth, 0

“Carrier No 397—Stool examinations since operation, 2, positive, 0, negative, 2, no growth, 0

SURGICAL TREATMENT OF BILE TYPHOID CARRIERS

"In view of the fact that many typhoid carriers are intermittent and some of them have negative stool findings for a number of years, it would be necessary to have statistics covering a long number of years before any definite conclusions could be drawn. Of the seven cases we have listed, four had at least one positive stool after operation.

"The attitude of the department, of course, is to keep watch on any cases which have been operated upon, hoping that sometime in the future we may be able to draw some definite conclusion in the matter of dropping them from our list of carriers as cured." At present there are some 260 active carriers listed in the New York City Board of Health

HAALAND SERIES

Cases operated upon for carrier state			14
B typhosus	5	Males	1
Paratyphoid B	9	Females	13
Cholecystectomy	13	Survived	13
Cholecystostomy	1	Died (sixth day) with cholecystectomy	1

Results

Cured by bacteriological control	11
Remain carriers	2

Analysis of fourteen cases operated upon at Presbyterian Hospital

B typhosus	13	Males	3
Paratyphoid B	1	Females	11
Known carriers before operation			8
Considered cured			6
Remain carriers			2
Probable carriers because of finding bacilli in gall-bladder bile, stones or gall-bladder tissue cultures at operation			6
B typhosus			5
Paratyphoid B			1
Considered cured			3
Not followed (bacteriologically)			1
Remained a carrier			0
2 died—third and seventeenth day after operation			
Of the two cases with cholecystostomy			
One cured—stools examined at 1, 16, 36, 60 and 85 months			
One remained a carrier during Board of Health follow-up of three years			
Of the twelve cases with cholecystectomy			
Two died. Both had cholangitis and pancreatitis at time of operation			
Of the ten surviving cases			
Stool reports not made			1
Apparently cured			8
Remains a carrier			1

It was the writer's impression that individual clinics had had a fairly large experience in the surgery of the typhoid carrier. It was not until last autumn that he learned from Doctor Haaland, of Bergen, Norway, that a large series was not available from any individual clinic and that our series at the Presbyterian was as large as any as yet reported. Haaland¹⁴ recently reported fourteen cases in the *London Lancet*. It happens that our series comprises the same number. Both his and our results are very similar and

offer more evidence in favor of cholecystectomy than do the statistics of other investigators. Haaland's cases differ from ours in that the majority of his patients showed the paratyphoid bacillus whereas thirteen of our fourteen cases were straight typhoid carriers.

In the Presbyterian series of fourteen cases three were operated upon by Doctor Auchincloss, eleven by the writer. Of these patients, six were operated upon during the late convalescence from typhoid for which they had been treated in the Presbyterian Hospital and where their carrier state had been established. All six were promptly cured of the carrier state. Of the remaining eight cases, three were sent to the writer as carriers—*i e*, they were known to be carriers for periods of six months to two years. The remaining five cases all were unaware that they were carriers, and three did not know that they had typhoid, in fact denied it. The two who acknowledged having had the disease gave the time of their typhoid as ten and sixteen years before the date of their operation. In the family of the patient who had had typhoid sixteen years previously the husband had had a very severe typhoid with perforation the year before she came for her operation and stated that the source of her husband's typhoid was difficult to explain as they had been living together that summer away from any possible source of infection.

Of these fourteen carriers, one had contracted her disease from a known carrier. The last patient operated upon by the writer was a woman, seventy-six years of age. She was one of several typhoid cases traced to a typhoid carrier in a missionary home. While she was in the hospital as a convalescent it was proven that she gave the disease to a patient in the ward. Knowing that she had contracted typhoid from a carrier and that she was a carrier herself she willingly consented to a cholecystectomy and now is freed by the Board of Health as a carrier.

Of those patients, two had a cholecystostomy done. One remained a carrier for three years and was then lost to the hospital and Board of Health follow-up. She refused cholecystectomy. Of the twelve cholecystectomized patients two died, but both these patients were deeply jaundiced and were operated upon for long standing gall-stone disease with cholangitis—*i e*, the inflammation had progressed beyond the gall-bladder into the duct system. Of the ten surviving cholecystectomies, all were cured of the carrier state except one patient who is still a carrier nine months after his operation. His duodenal bile still shows typhoid bacilli and he has to be classed as a liver carrier.

Comparing Haaland's fourteen cases with our series, he reports thirteen cholecystectomies and one cholecystostomy. One of the cholecystectomies died six days after operation. Of the thirteen survivors, one remains a liver carrier, one a liver and urinary carrier—*i e*, eleven of the thirteen have been freed for periods of six months to five and a half years, or, 84.5 per cent of Haaland's cases were cured. Eighty-three and three-tenth per cent of our cases are considered cured by surgery.

SURGICAL TREATMENT OF BILE TYPHOID CARRIERS

In dealing with the typhoid carrier problem we have to consider these points

1 A convalescent from typhoid fever should have at least one negative duodenal culture and three negative successive stool cultures before being discharged to the community

2 If his tests show continued presence of bacilli in his duodenal bile he has to be considered a bile carrier. If his bile is negative but his stool positive he belongs to the rare form of intestinal carrier and is not amenable to surgery

3 If, at the end of three months, the patient still continues to show bacilli in his duodenal contents he must be considered a chronic bile carrier

4 If there has been any symptom of cholecystitis or if a cholecystogram shows evidence of abnormal concentration of dye or the presence of gall-stones, the probabilities are very great that the focus is the gall-bladder

5 The presence of a gall-stone porous and pervious to typhoid bacilli, prevents the gall-bladder from freeing itself of infection, for it both hinders mechanically the emptying of the gall-bladder and reinfects the fresh, incoming bile

6 Certainly if the chronically infected gall-bladder, with or without stones continues to reinfect the liver and bile passages long enough, the probabilities of the individual becoming a duct or liver carrier as well as gall-bladder carrier increase as time goes on. It may be that the sacculi in the wall of the common duct become the seat of infection

7 To the intelligent and conscientious individual the mental distress and the stigma of being a carrier are very great, and to every carrier the physical and occupational restrictions and the constant surveillance of the health authorities are so irksome as to make every sensible carrier anxious to undertake any measure that offers a good chance of cure. The ignorant or lawless carrier who breaks parole is subject to incarceration, but it is this type that usually refuses surgery and remains a charge and menace to the community

8 For the chronic bile carrier surgery is the only measure that offers any possibility of a cure. A cholecystectomy gives probably a 70 per cent chance of cure. If the operation is done while the disease is limited to the gall-bladder the risk of the operation in competent hands is less and the chance of cure greater than if the duct system is involved

9 If at the time cholecystectomy is done the common duct is drained through the stump of the cystic duct, it can be determined by culturing the common-duct bile whether the ducts are free. If they are infected the continuous free drainage of bile, as pointed out by Garbat, favors the sterilization of the liver and duct system. We believe this is an added factor in insuring a cure of the bile carrier

10 Inasmuch as the great majority of bile carriers have gall-stones and chronic cholecystitis the operation is not necessarily *pro bono publico*, but may be looked upon as of benefit to the individual as well as to the community

ALLEN O WHIPPLE

History number	Sex and age	Date of typhoid	Date when recognized as carrier	Widal	Culture of urine	Culture of faeces	Culture of duodenal contents	Operative findings					Post-operative findings					Follow up Notes
								Operation	Pathology of gall bladder	Gall stones	Culture of bile	Culture of gall-bladder wall	Duration of fistula	Culture of urine	Culture of faeces	Culture of duodenal contents	Widal	
334079	M 36	1907	1917	+	o	+	o	o	Chronic inflammation	C D	+	in C D	+	o	16 days	+	+	16 36 60 85 months all negative for B typhosus Urine examination 60 months negative
37180	F 22	Denied	1917	o	o	o	o	o	Chronic and acute cholecystitis	+	+	in GB C D	+	+	14 days	o	+	Stools became negative on sixteenth day and at the end of one month Patient then lost to follow-up
37525	M 56	Denied	1924	o	o	o	o	o	Chronic cholecystitis and chronic cholangitis	+	+	in GB C D	+	+	17 days	+	+	Died of uraemia and pancreatitis on seventeenth day shown by autopsy
39495	F 28	1918	1918	+	+	+	o	o	Acute suppurative cholecystitis	+	+	in GB C D	+	o	3 mos	+	+	Remained a carrier for three years and then was lost
55540	F 42	1922	1922	+	+	+	+	+	Chronic cholecystitis	+	+	in GB C D	+	+	None	+	+	Had several examinations of the faeces for a period of three months all negative Has been seen at interval of twelve twenty-four seventy two months Is in excellent health
58469	F 38	Denied	1923	o	o	o	o	o	Chronic cholecystitis	+	+	in GB C D	+	o	No e	o	o	Was followed for a period of twenty-four months but stool cultures were not done
60990	F 17	1925	1925	+	+	+	+	+	Chronic cholecystitis	+	+	+	+	+	Nore	+	+	Board of Health freed the patient after one negative duodenal bucket test and three negative stools Thirty-three months follow up is in excellent health
65694	M 53	1920	1923	+	+	+	+	+	Chronic cholecystitis	+	+	+	+	+	6 week	+	+	One year later an operation for common duct stricture showed the common-duct bile free from typhoid

SURGICAL TREATMENT OF BILE TYPHOID CARRIERS

60100	1	32	1911	1927	0	0	0	0	1927 -ectomy	Chronic cholecystitis	+	+	None	0	+	4 days then	0	+	+
Patient's husband had a very severe typhoid the year before while in camp in Maine with his wife. Patient followed for sixteen months, freed by Board of Health in New Jersey. Has been followed for two years. Is in perfect health. Stool cultures negative (3). Freed by Board of Health as carrier. Has remained well for eighteen months when last seen. Died of cholera and peritonitis on the fourth day.																			
60016	1	22	1925	1925	+	+	+	+	1927 -ectomy	Chronic cholecystitis	+	+	None	1	+	— after 4 days	1	+	+
60591	1	35	1927	1928	+	+	+	+	1928 -ectomy	Chronic cholecystitis	+	+	None	0	+	— after 10th day	0	+	+
70827	1	57	para 1926	1928	0	0	0	0	1928	Chronic cholecystitis chronic and acute cholangitis	Paratyphoid B	+	None	0	+	0	+	+	+
71180	1	18	1927	1927	+	+	+	+	1928 -ectomy	Chronic cholecystitis	+	+	None	1	+	+	1	+	+
70101	1	76	1927	1928	+	+	+	+	1928 -ectomy	Chronic cholecystitis	+	+	None	1	+	+	1	+	+
Has remained a carrier for the last year when last heard from. Contracted typhoid from a carrier. Has been followed for eight months and her last stool culture, eight months after operation was negative for typhoid.																			

DISCUSSION

11 Every carrier operated upon should be followed and if possible two duodenal cultures and three stool cultures, negative for typhoid, should be obtained before declaring the carrier cured. These statistics should be made available for Board of Health authorities so that the uncertainty as to the results of cholecystectomy now so prevalent may be replaced with facts.

From the fact that five of the fourteen cases in the Presbyterian Hospital series were found to be carriers only as a result of routine cultures of the gall-bladder bile and gall-bladder tissue, the point is to be emphasized that bacteriological studies of the bile and gall-bladder tissue from the tissue removed at the time of operation have, in addition to others, the advantages of detecting possible carriers that may subsequently be found to be permanent duct or liver carriers. Such cases, of course, should be reported to the local Departments of Health so that these individuals will not continue to be a menace to the community.

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DISCUSSION. DR EMMET RIXFORD, of San Francisco, Cal., remarked that it would seem that the obvious thing to do is to make routine bacteriological examination of the gall-bladder or the contents in all cases of cholecystectomy or cholecystostomy, whether there is a history of previous typhoid fever or not. Not very long ago he recovered living typhoid bacilli from the contents of the gall-bladder in a lady of sixty-five years, and subsequently found the bacilli in the stools. The lady was positive she had never had typhoid.

fever. It was several months after the cholecystectomy before the stools were free of typhoid bacilli.

Not long ago there was an epidemic of typhoid fever in San Francisco which was traced to a carrier among the employees of a dairy. The Board of Health ordered that the man be not employed in any food purveyor's establishment, and especially not in any dairy. The labor unions put very great pressure on the Board of Health to have that order rescinded on the ground that the man could not work to advantage except in a dairy and he had a right to earn his living. We had quite a merry fight over the thing.

DR EDWARD P. RICHARDSON, of Boston, Mass., said that the State Department of Health in Massachusetts, if it finds a typhoid carrier who is also a food handler, attempts to persuade that person either to change his occupation or to be admitted to a hospital for the purpose of operation. The State of Massachusetts has provided a small sum to cover the hospital care of such individuals as are operated on.

The indication for operation when such a carrier is admitted to the hospital, provided the patient is a good operative risk, is a positive culture of the typhoid bacillus on duodenal intubation. At the Massachusetts General Hospital there have been eight such cases operated upon and each one had a pathological condition in the gall-bladder which would justify cholecystectomy.

These cases have recovered from operation and by it have been converted from carrier individuals to those with a negative stool culture.

DR FRANK S. MATHEWS, of New York City, asked whether all the patients that Doctor Whipple had operated upon who were typhoid carriers also had stones. It had been the speaker's impression that the way the condition is brought about is that in an epidemic of typhoid, those persons who get the disease and already have stones become carriers. Chauffard, in his "Leçons Sur La Lithiase Biliaire" has called attention to the fact that persons who have typhoid do not frequently come to operation for gall-stones within a reasonably short time and hence argues that typhoid does not cause stones. The suggestion, then, is that carriers as a rule become carriers because they have gall-stones rather than develop stones as a result of a typhoid. There seems little evidence that typhoid *per se* is a cause of gall-stones.

DR ALLEN O. WHIPPLE (in closing the discussion). In regard to the incidence of gall-stones in these patients twelve of the fourteen cases in his series did have gall-stones, and one or two of them within a period of three months after the disease. He believed undoubtedly that the presence of a porous foreign body in the gall-bladder containing the typhoid bacilli is the chief factor in continuing the typhoid strain in these carriers.

In dealing with the typhoid carrier problem one has to consider these points. First. A convalescent from typhoid fever should have at least one negative duodenal culture and three negative, successive stool cultures before being discharged to the community. If his tests show continued presence of bacilli in his duodenal bile he has to be considered a bile carrier. If his bile is

DISCUSSION

negative but his stool positive he belongs to the class containing the rare form of intestinal carrier and is then not amenable to surgery

If at the end of three months the patient still continues to show bacilli in the duodenal contents he should be considered a chronic bile carrier. If there have been any symptoms of cholecystitis, or if the cholecystogram shows no evidence of the dye or the presence of gall-stones, the probabilities are very great that the focus is the gall-bladder. The presence of a gall-stone, porous and pervious to typhoid bacilli, prevents the gall-bladder from freeing itself from infection and the re-infection of the incoming bile.

Certainly if the chronically infected gall-bladder, with or without stones, continues to re-infect the liver and bile passages long enough, the probabilities of the individual becoming a duct or liver carrier, as well as a gall-bladder carrier, increases as time goes on. It may be that the parietal sacculi in the wall of the common duct become the seat of the infection.

To the intelligent and conscientious individual the mental distress and the stigma of being a carrier are very great. To every carrier the physical and occupational restrictions and the constant surveillance of the health authorities are so irksome as to make every sensible carrier anxious to undertake any measure that offers a good chance of cure. The ignorant or lawless carrier who breaks parole is subject to incarceration. This is the type that refuses surgery and remains a menace to the community.

Regarding what Doctor Homans had said in the cases coming to operation, they had found six of these carriers because of the routine culture of the bile and gall-bladder tissue. They would never have known that they were carriers, or potential carriers, but for that. Furthermore, in one of their cases they found that the patient, even after the gall-bladder was removed remained a carrier for a period of some three months. The routine culture, therefore, of bile and gall-bladder tissue is worthwhile whether or not the patient gives a history of typhoid.

THE FOWLER POSITION AND ITS RELATION TO DILATATION OF THE STOMACH

BY CHARLES L GIBSON, M D

AND

PRESTON A WADE, M D (By Invitation)

OF NEW YORK, N Y

THE semirecumbent position, generally known in this country as the Fowler position, was originally introduced as a therapeutic measure in the treatment of acute peritonitis, particularly following appendicitis, and its value seems to have been unquestionable

After several years of use of it in these conditions I got the impression that we had perhaps relatively more trouble, paresis or even mechanical disturbance of the intestine, after operation and instituted the practice of putting patients in the flat position as soon as improvement was manifest, usually about thirty-six hours post-operative, with apparent benefit

The Fowler position has gradually been utilized more and more in the treatment of operations in the upper abdomen, particularly the gall-bladder and stomach. The reasons for using it in these conditions vary. I think most operators felt that the patients were more comfortable and were less likely to develop pulmonary manifestations

It seemed to me, however, as time went on that many of these patients seemed, even after relatively simple operations, to develop more stomach symptoms, particularly those of a dilatation, requiring lavage, postural treatment, etc

The explanation might be of several kinds, one, perhaps, being the compression of the duodenum by the drag on the superior mesenteric artery by the crowding down of the intestines in the pelvis, especially when the intestines were unduly full of gas. Recently, therefore, we decided to put these patients in the flat position and we have some statistics which seem to show diminution in the amount of post-operative dilatation as judged by the necessity of lavage of these cases

Meanwhile, we have kept track of the pulmonary complications (bronchitis, pneumonia, massive atelectasis and pulmonary embolism) and we are gratified to note that there has been only a 2 per cent increase in the pulmonary manifestations

Perhaps more convincing in my personal experience is a small but important series of private cases, most of them of considerable severity—resection of the stomach, cholecystectomy, etc—in which the stomach tube has now been discarded for a year and a half and without any noteworthy pulmonary complications at any time

This paper, therefore, is offered as a possible hint in the direction of post-operative treatment

An analysis of 249 cases has been made by Dr Preston A Wade, assistant surgeon, and a comparison of the two periods has been made—the Fowler position being figured from January 1, 1927, to March 1, 1928, and the flat position from March 1, 1928, to May 1, 1929

It will be noted that the greatest benefit seems to be in the various operations on the gall-bladder in which the post-operative stomach manifestations (dilatation) have been reduced from 43 per cent to 20 per cent

ANALYSIS OF 249 CASES

Fowler position—141

Flat position—108

	Number of cases lavaged	Per cent
<i>Chronic cholecystitis</i>		
Fowler position—26	9	34
Flat position—31	5	16
<i>Cholelithiasis</i>		
Fowler position—39	19	48
Flat position—3	0	0
<i>Acute cholecystitis</i>		
Fowler position—8	4	50
Flat position—10	4	40
<i>Ulcer of stomach</i>		
Fowler position—12	5	41
Flat position—4	1	25
<i>Perforating ulcer stomach</i>		
Fowler position—6	2	33½
Flat position—8	2	25
<i>Ulcer of duodenum</i>		
Fowler position—19	11	58
Flat position—29	9	31
<i>Perforating ulcer duodenum</i>		
Fowler position—15	1	6
Flat position—11	1	9
<i>Carcinoma of stomach and gall-bladder</i>		
Fowler position—16	5	34
Flat position—12	2	16
<i>Total gall-bladder cases</i>		
Fowler position—73	32	43
Flat position—44	9	20
<i>Total stomach and duodenal cases</i>		
Fowler position—68	24	35
Flat position—64	15	25
<i>All cases</i>		
Fowler position—141	56	39
Flat position—108	24	22

THE REMOVAL OF WIDE SCARS AND LARGE DISFIGUREMENTS OF THE SKIN BY GRADUAL PARTIAL EXCISION WITH CLOSURE

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OF BALTIMORE, MD

FROM THE SURGICAL DEPARTMENT OF THE JOHNS HOPKINS UNIVERSITY AND HOSPITAL

THE question of removing a wide scar or a large disfigurement of the skin, without leaving a result which is as objectionable as the original trouble, has always been a difficult problem in plastic surgery, and the object of this paper is to call your attention to a simple method by which this may be accomplished.

It should be understood that the disfigurements considered here are of benign character only, as it would be disastrous to attempt the removal of malignant skin lesions by gradual partial excision.

As far as I can ascertain, the first communication on the subject was by H. Morestin, who in June, 1915, read a paper before the Society of Surgery of Paris "*La réduction graduelle des difformités tégumentaires*." It was my good fortune to see this report soon after the publication of the Bulletin of the Society and I immediately realized the great importance of the contribution and utilized it at once.

It was only necessary to try the method to become convinced of its value, and I have since then used gradual partial excision with satisfaction on a great many cases. The method has also been taught to students in my division for years.

Sistrunk reported "*A Method of Removing Scars in Stages*" in 1926, being unaware of earlier work along the same lines. Strange as it may seem little general notice has been taken of this important plastic principle.

Gradual partial excision is the progressive reduction in size of a disfigurement by successive excisions, which are repeated at variable intervals. The method depends for its success upon the fact that the normal skin has a tremendous capacity to stretch, especially when the stretching is done slowly.

It may be asked why should multiple operations be undertaken when the disfigurement might be removed at a single operation and the resulting defect be covered by a skin graft or by the shifting of a pedunculated flap. The answer to this question is that the procedure is simpler and the ultimate result, in suitable cases, is very much better. It may also be asked why radium or X-ray could not be used to obliterate some of the disfigurements, such as hæmangiomas. The answer is, that radiation had already been tried unsuccessfully in a number of the cases subsequently relieved by gradual partial excision and, unfortunately, in some instances the original condition was complicated by ray burns.

Morestin reported several cases, among them the removal of an extensive pigmented mole on the face of a child. He operated on this patient twelve times in a little over four months. Another case, a burn scar of the neck and

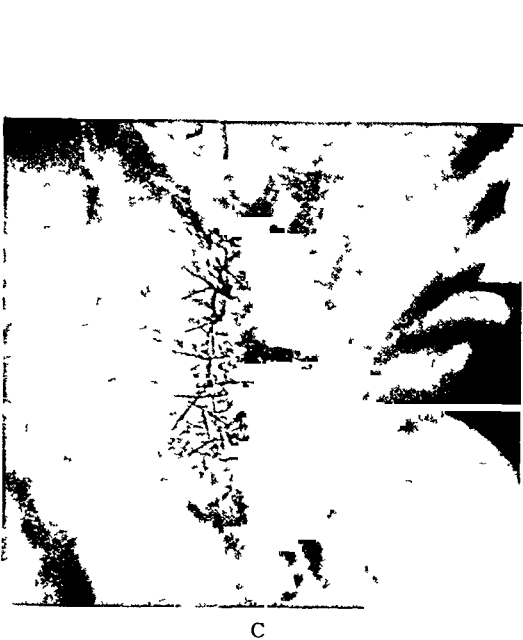
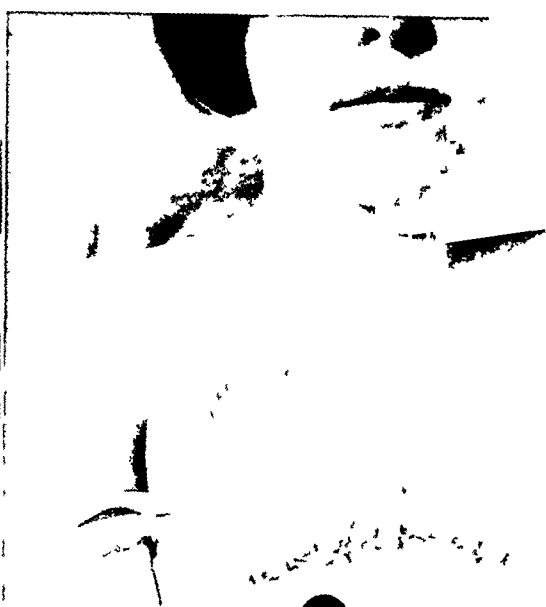


FIG. 1—X ray burn following multiple treatments for glands of the neck. Illustrating the first step of gradual partial excision with closure. A Shows typical changes caused by X rays, keratosis, frequent ulceration, atrophy, telangiectasis, pain and stiffness. B Shows the ellipse of tissue removed fifteen centimetres long by five centimetres at the widest part. C, Shows the wound one week after operation. Note type of closure. D, Result after four weeks. Note that the most objectionable portion of the tissue has been removed. The scar is narrow and healing has been satisfactory.

THE REMOVAL OF WIDE SCARS



A



B



C



D

FIG 2—The removal of a burn scar of many years' duration by gradual partial excision with closure. A Note the size and location of the scar on the neck and upper chest wall. B The result of the first excision after eight months. Note the narrowing of the scar. C, Result of the second operation after nine months. The scar is much narrowed and the surrounding skin has stretched so that there is no tension. D, Result of the third excision with closure. Photograph taken sixteen days after the operation. The original scar has been practically entirely removed. The result will be a line scar and if this tends to spread in places, it may be narrowed, otherwise nothing further may be necessary. There is no limitation of neck movement, and the skin has stretched to meet the demand placed upon it.

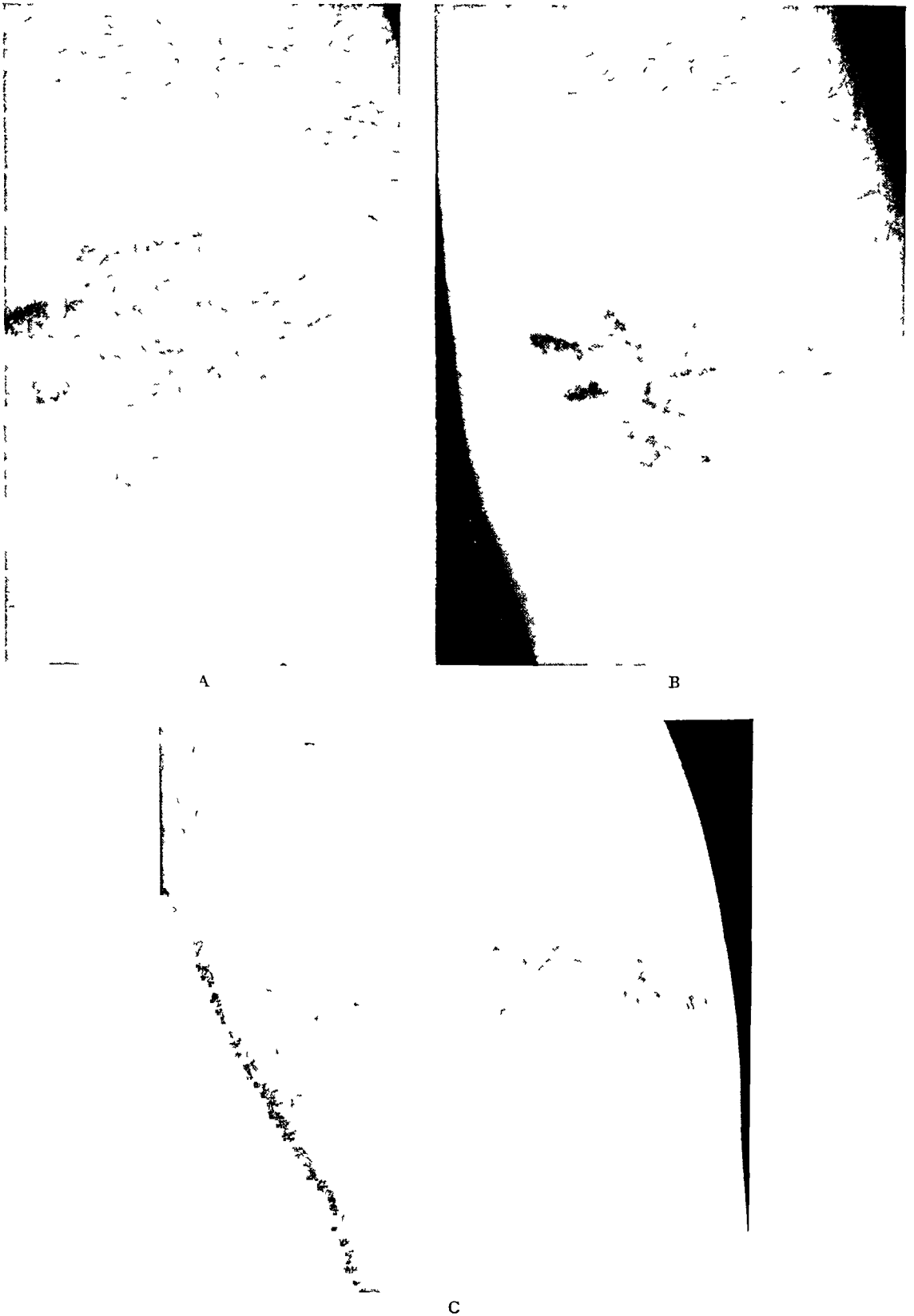


FIG 3—Tattoo marks on the forearm. Removal by gradual partial excision with closure. A Actual size of the design. B Five weeks after the first ellipse of tissue was removed. Note the narrowing of the pigmented area and the type of scar. C, Result of second step in the removal. Note the small area of the design which remains.

breast, was operated on eighteen times in eleven months. In my series the number of operations necessary to accomplish the desired result has varied between two to twenty, depending on the size and character of the disfigurement.

Method—The part may be prepared in any way selected by the surgeon, but when dealing with scar infiltrated tissue, soap and water followed by alcohol and ether usually cause less subsequent irritation than when stronger chemical antiseptics are employed.

When the area to be excised is small, there is no necessity for the patient being hospitalized, but where the areas are larger, hospitalization is advisable. Local anæsthesia may often be used, preferably by nerve or regional block, as infiltration distorts the tissues, makes the closure more difficult, and may interfere with healing, especially when dealing with scars. If the disfigurement is on the face or neck, and general anæsthesia is required, ether by the colonic route is the method of choice, otherwise gas and oxygen, or ethylene may be used.

Technic—After determining the amount of tissue to be excised from the disfigurement, outline it with 5 per cent brilliant green in alcohol before the anæsthesia is given, as in this way we eliminate any question as to the size, shape and situation of the area to be removed, after the patient is draped. The pattern is usually made in the shape of an elongated ellipse whose long axis, in order to facilitate closure, is in the most advantageous direction, but any shaped area may be removed as long as the resulting defect may be closed by suture.

The marked out portion should be cleanly excised with a sharp scalpel down to normal tissue, care being taken to avoid unnecessary injury to the edges which are to be approximated. All hæmorrhage should be checked. Then the edges are approximated with a few catgut or fine waxed silk sutures in the subcutaneous tissue and on-end mattress sutures of horse hair or waxed silk in the skin. The disfigurement is thus reduced in size by the amount of tissue removed. On the sutured wound place one thickness of gauze impregnated with 3 per cent xeroform ointment, or several layers of silver foil with its porous paper, and over this a sterile sea sponge applied under even pressure and snugly secured with adhesive plaster and bandage.

In many instances, on account of the character of the tissue dealt with, it is impossible to make the closures following the primary and intervening operations as accurate as might be desired, but every effort should be made to have the final closure as perfect as possible. After an interval, the length of which varies according to the situation, and when the surrounding skin has stretched sufficiently, more of the disfigurement is excised in the same way, the selection of the portion to be removed depending on conditions. This procedure is continued at suitable intervals until the disfigurement has been completely removed and a narrow scar remains.

The successive excisions should ordinarily be made inside the area of the scar or disfigurement until the final step is reached, when it may be necessary to encroach slightly on the surrounding tissue. By proceeding in this way the

resulting narrow scar will be little if any longer than the long axis of the disfigurement. Should the excisions extend into the normal skin beyond the margins of the disfigurement then naturally the resulting scar will be longer.

Remarks—The technic is simple and these operations are seldom attended by any danger. In the process of gradual partial excision, there is no contraindication to cutting through large pigmented naevi, extensive hairy moles, cavernous angiomas, or keloids.

It is advantageous when dealing with scars to gain everything possible before both the primary and the secondary operations by preliminary massage and motion, thus loosening and softening the scar and mobilizing the surrounding skin.

The amount which it is safe to excise varies with the elasticity of the skin around the disfigurement and the determination of this point is sometimes a nice one, as it is essential in carrying out the procedure that the wound be immediately sutured and that perprimam healing follow. Occasionally one miscalculates and removes too large an area of tissue and if the defect left by this removal cannot be closed by sutures even under considerable tension, then it becomes necessary to undercut before closure is possible. Ordinarily, I prefer not to undercut as undercutting tends to make more scar, and the tissues do not loosen as readily for the secondary operations.

In some of his cases, Morestin operated a second time within three or four days and where the skin surrounding the growth is normal and quite lax this may be permissible. However, I have found it advisable in the majority of cases to let a considerable period of time elapse between operations, and in my experience this is essential especially where the maximum single excision has been done, and also particularly where the tissues are scar infiltrated. Where small areas have been removed the skin may stretch sufficiently in a week or two, but I have frequently allowed six months or more to elapse between operations.

It is difficult to appreciate the possible extent of gradual stretching of the surrounding skin and its adaptability, unless one is conversant with this procedure. Scars and disfigurements on the nose, eyelids and other parts of the face must be handled with great care, as considerable deformity may follow injudicious excisions. When dealing with angiomas I have found it useful to surround the growth with a thick lead wire which is pressed firmly into the tissues by an assistant, until the excision is done and the wound is closed. In this way bleeding, which otherwise may be severe, is minimized.

When gradual partial excision is used in removing a keloid, the excision is done entirely in the growth itself, all sutures being placed so that they pass through the keloid tissue. Exactly the same process is repeated from time to time as the skin stretches. The final result will be a narrow flat scar instead of the prominent thickened growth. Suitable preliminary X-ray treatment is used on keloids before excision is undertaken.

When dealing with a large scar, say on the neck, it will often be found that there is tissue which can be easily removed in different portions of the scar, and in such a case it is advisable to excise the several smaller areas rather than

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FIG 4.—Hemangioma of the forearm involving the skin and subcutaneous tissue. Treatment gradual partial excision with closure. A, Before operation. Note the size, shape and situation of the growth. B, Result six months after the excision of the first ellipse of tissue. Note the scar and the diminution in size of the angioma. C Three months after the second excision. Comparatively little of the growth is left. All of the subcutaneous involvement has been removed and the superficial portion which remains can be easily removed, either by excision or by carbon dioxide snow. Note the longitudinal scar and compare this stage with the original condition.



A



B



C

FIG 5—Illustrating the treatment of keloid by gradual partial excision. A Shows the keloid before preliminary X-ray treatment was given and gradual partial excision was commenced. B The growth was removed in several stages over the period of a year and the photograph shows the final result. C Shows the same area four years later. This indicates the permanence of the results obtained by this method.

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to attempt the removal of a single larger piece. The sutured wounds in such a case may run in several directions. The removal of a scar with more or less infiltration of the surrounding skin is much more difficult than when it is surrounded by normal skin, as scar infiltrated skin does not stretch nearly as much as does normal skin. However, such scars can gradually be reduced in size by gradual excision of suitable areas and in many instances excellent results may be obtained.

The procedure takes time and cannot be done in a hurry. It requires considerable patience from both surgeon and patient, but in the great majority of cases, the improvement which soon becomes evident is sufficient to stimulate further mutual effort.

In most instances, if carried out properly, gradual partial excision will remove the disfigurement and frequently the result will be a narrow scar, which may be either straight, or curved, or angled, depending on the way in which the excisions have had to be made. Often it can be managed so that the final scar will lie in a natural fold. Occasionally, it is impossible to completely eliminate a deformity by this method, but the size of the defect may in this way be reduced sufficiently to make a simple plastic procedure possible where the original condition would have necessitated a large mutilating operation, and this in itself is well worth while.

I have used gradual partial excision with closure successfully in removing extensive scars, large pigmented moles, pigmented nævi, hæmangiomas, lymphangiomas, tattoo marks, X-ray and radium burns, localized scleroderma, keloids, etc., and have found that by this procedure these cutaneous disfigurements may be eliminated without mutilation, and that better results may be obtained than by any other method with which I am familiar.

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DISCUSSION. DR. WALLACE I. TERRY, of San Francisco, Cal., asked Doctor Davis if the X-ray burns are ultimately taken care of. He had treated according to his method, a young woman who had been X-rayed for goitre. He had removed all of the original scar but the discoloration and the dilated veins remain. Will they disappear afterward?

DOCTOR DAVIS replied that they do not disappear unless they are taken out. Where there is a widespread X-ray burn with varying degrees of skin change, that portion in which there is keratosis and ulceration should be removed with a wide margin. The less immediately important areas such as those showing telangiectatic changes being left to be excised subsequently if necessary.

TRAUMATIC RUPTURE AS A SEQUENCE TO CONGENITAL HERNIA OF THE DIAPHRAGM, WITH AN EXPERI- MENTAL STUDY OF ITS MECHANISM AND THE EFFECTS OF PHRENICOTOMY

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ANY abnormality which interferes with the vital functions of respiration, circulation, and digestion warrants the utmost reflection. Therefore, it is my hope that this report which embraces the results of further observation and study of the diaphragm, disabled by hernia or phrenic nerve paralysis,

may be of practical interest. The sphere of thought and action in surgery is replete with entangled and intricate problems, but few are more perplexing than those associated with a breach in so important a structure as the diaphragm.

A review of the literature reveals the element of surprise frequently attending the discovery of diaphragmatic hernia. Escaping in the physical examination it is disclosed by the Rontgen-ray, during operation, or at autopsy. The clinical pre-operative diagnosis, however, is of great importance

especially when acute intestinal obstruction supervenes. The recognition of diaphragmatic hernia on physical examination will be made more often when physicians are on the alert for its weird manifestations. This is borne out by the fact that in one small hospital, the Goddard, at Brockton, Mass., two cases have been discovered, the first at operation, the second on physical examination. The transposition of organs, abdominal and thoracic, must be recognized by the examiner, for this is the key to the diagnosis.

Furthermore, the existence of congenital heart disease or enlarged thymus as a cause of cyanosis and dyspnoea in the new-born should not be considered



FIG. 1.—Case No. 17609—A. C. Harelip

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final until the presence of diaphragmatic hernia, or eventration of the diaphragm has been ruled out. Acidosis, dysphagia, pyloric obstruction, vomiting, constipation, dehydration, cough, and cataleptiform seizures are symptoms of hernia of the diaphragm in infancy and childhood. Their importance in this relationship may be overlooked, not because diaphragmatic hernia is rare but because it is rarely in the mind of the examiner.

The following case resembled whooping cough, for which the patient was treated until a differential diagnosis was accurately made by Dr. P. H. Leavitt, of Brockton, Massachusetts. This case was of further material importance in demonstrating the occurrence of a major tear through the entire diameter of the diaphragm from the margin of a congenital hernia.

Since I have been unable to find the report of a similar observation in literature, I present our findings in this case with some trepidation. The evidence, however, appears to be determinate. The presence of harelip (Fig. 1), the continuity of pleura and peritoneum over an elliptical area close to the oesophagus,

and a tear extending from this point to the periphery of the diaphragm provides a collection of facts, any other interpretation of which would be difficult. The most plausible explanation would seem to be that a sliding hernia of the stomach filled at the moment with food or gas was suddenly and violently forced through the aperture. Something had to yield and the structure least capable of resisting was the diaphragm, the rent in which stopped only at its perimeter. From the length of the tear, which gave rise to an expanded open area, one might be led to suppose that the immediate transposition of abdomi-

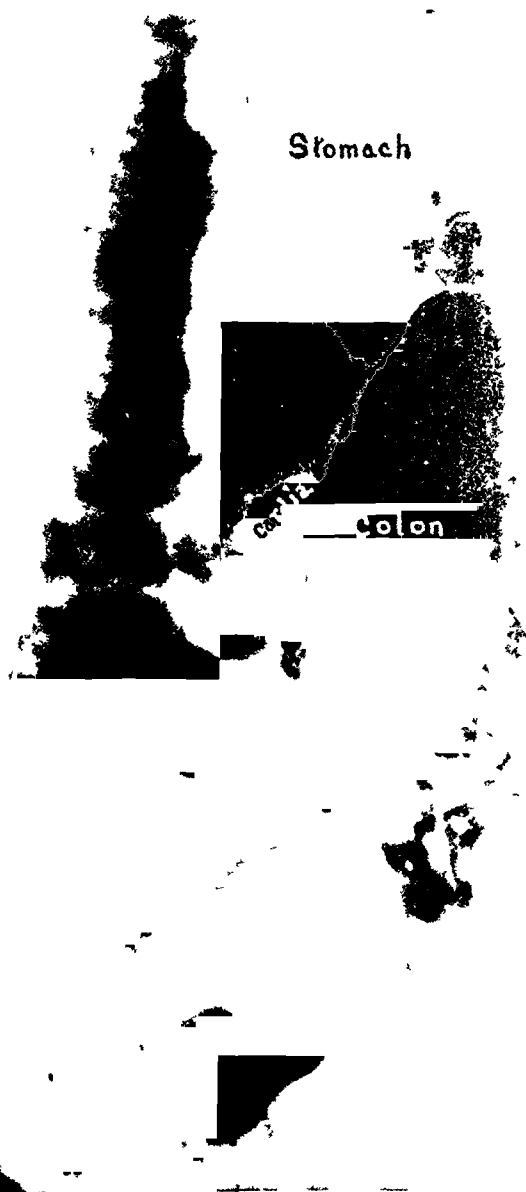


FIG. 2—Congenital hernia of the left diaphragm converted into complete rupture by external violence.

nal viscera would collapse the left lung, displace the heart, and cause death from asphyxia. Later in this paper I shall present experimental evidence

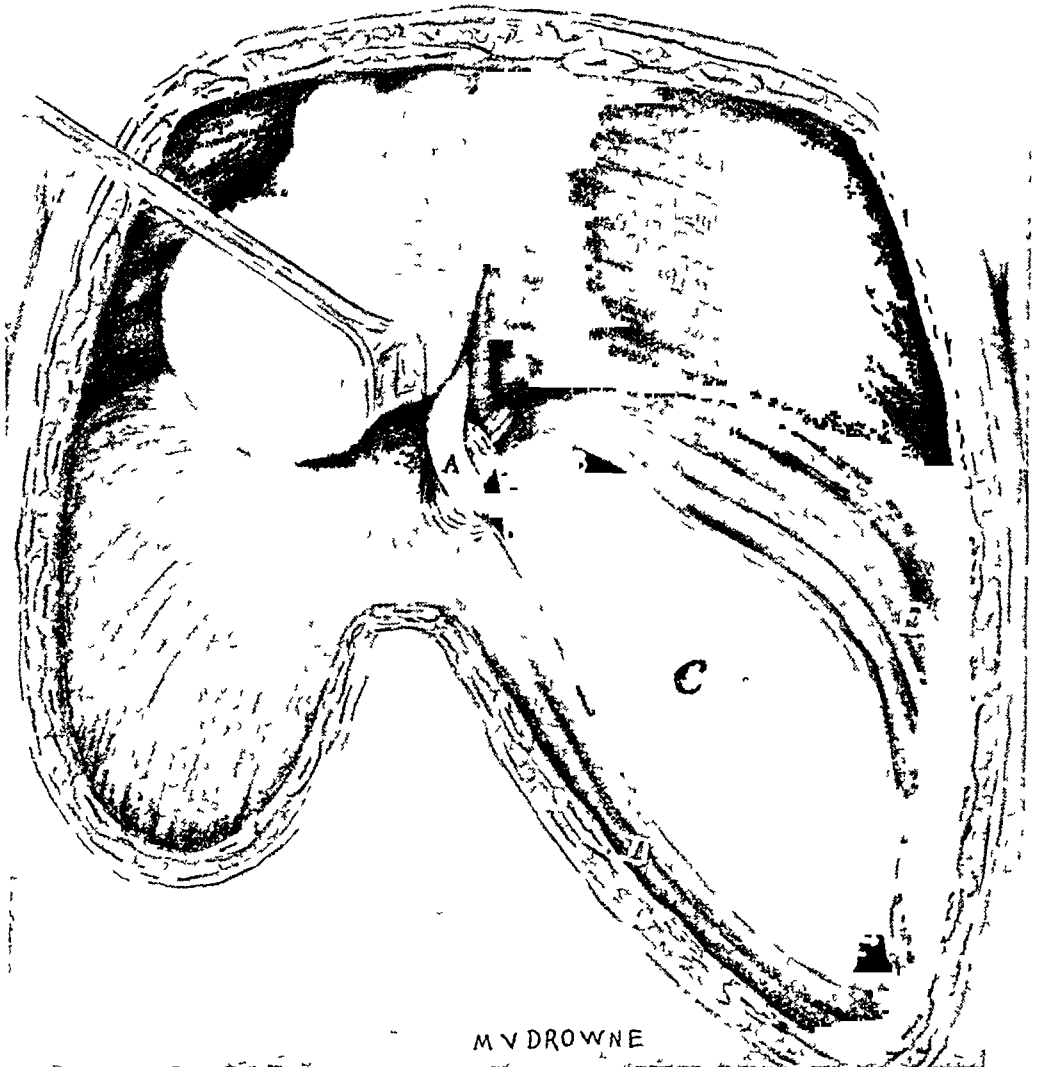


FIG 3—Complete rupture of the left diaphragm. Evidence of a preëxisting congenital hernia was observed in the œsophageal region. The tear extended outward from the margin of the congenital opening to the perimeter of the diaphragm. A, œsophagus, B, area of congenital defect, C, area of traumatic rupture, D, anterior leaf, E, posterior leaf, F, outer angle of tear.

showing clearly that the transposition of organs even in the presence of a very large opening in the diaphragm is not rapid but so gradual that it allows for a compensatory mechanism sufficient to sustain life.

CONGENITAL HERNIA AND RUPTURE OF DIAPHRAGM

CASE REPORT—A C, girl, five years of age, was struck by an automobile March 29, 1928, receiving injuries to her body and right leg. At the Goddard Hospital, Brock-



FIG 4—Exposing the field of operation through a trapdoor incision in the thoracic wall. The ribs are not removed. Structures to be seen are the stomach, small intestine, colon, omentum, pericardium, left lobe of the liver and the spleen. A, Stomach, B, heart, C, omentum, D, colon, E, liver, F, spleen.

ton, Massachusetts, it was determined that the little patient had a fracture of the right femur. This was treated by the use of traction and later the application of a plaster

case During her stay in the hospital she developed a peculiar cough, so closely simulating whooping cough that she was treated for it over a period of several weeks Dr P H Leavitt, suspecting the possibility of a diaphragmatic hernia from the persistence of cough and a dextrocardia, ordered a Rontgen-ray examination of the abdomen after a barium enema This revealed a loop of the transverse colon extending well up into the left pleural cavity She was kept under observation and placed on medical treatment for a few weeks during which time her general condition improved materially

May 13 she was referred to our clinic On admission her temperature was 100.8°

and her pulse 140 There were the usual symptoms of emotional cyanosis, dyspnoea, rapid pulse, rapid respiration, cough, precordial distress, sunken abdomen, and distended chest Litten's sign could not be observed because the child could not lie down without becoming cyanotic In observing a paroxysm of coughing we noticed that it lacked the characteristic inspiratory "whoop" of pertussis Cyanosis and dyspnoea were more marked when the patient assumed the recumbent position

On physical examination the first feature to attract attention was harelip The concomitant appearance of harelip and diaphragmatic hernia prompted a minute examination of the texture of the diaphragm in the region of the aperture

A Rontgen-ray examination after a barium meal revealed the entire stomach in the left thoracic cage Small scattered shadows indicated the transposition of the small intestine (Fig 2) May 19 a preliminary cecostomy was



FIG 5—After operation

done There was difficulty in locating the cæcum because it had been drawn upward toward the diaphragm Improvement followed and the major step of repair was undertaken May 26 Gas oxygen ether anaesthesia was employed By means of an approach through a trapdoor-opening in the thoracic wall the left pleural cavity was found to contain the entire stomach, the small intestine, the transverse colon, the left lobe of the liver, the spleen, and the omentum (Fig 4) There was no constricted point of transit, nor could either margin of the torn diaphragm be defined At this point it was thought that there was a congenital absence of the diaphragm, yet the displaced abdominal viscera were reduced without difficulty The left lung was then found to be collapsed Close inspection revealed anteriorly a shelf of diaphragm varying along its course from two to six centimeters in width, the narrow portion being about midway, the broadest internally

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where it merged into a cup-shaped fold of serous membrane. Further search resulted in finding the remainder of the diaphragmatic leaf in folds along the posterior wall of the thorax (Fig 3). Believing that it would expedite matters we began the application of sutures in the region of the œsophagus first where closure of the aperture, technically, would be more time-consuming. On account of the difficulties met at this point the constant intrusion of hollow viscera at the outer angle of the split diaphragm and a failing heart beat readily discernible in the foreground, a shift in method of closure was adopted. Using No 3 chromic catgut, a running suture was started at the outer angle of the tear. This was continued to a point where all gauze packing could be removed without fear of exposing further the upper abdominal contents. After a brief pause the patient's heart action improved. Closure of the more delicate œsophageal end of the opening was then accomplished. Finally a running suture of fine silk was employed to reinforce the chromic catgut throughout its length. The opening in the thoracic wall was then closed.

During that period of the operation when there was anxiety over the failing heart action, traction was made on the central attachments of the diaphragm and upon the fibers attaching the pericardium to the diaphragm. The object to be achieved by pulling on any portion of the displaced mediastinum was to permit a greater quantity of air to enter the right lung, already considerably limited in its area of expansion. While improvement in the patient's condition followed, there still

remains some doubt as to the agency which brought it about. However, in our experiments upon dogs without use of the mechanical respirator we found that traction on the displaced mediastinum improved the condition of the animal.

Convalescence of the child was marked by a wide range of temperature and pulse. May 30 about 300 cubic centimeters of turbid fluid was aspirated from the left pleural cavity. June 2 the pleuritic effusion had become purulent, and a rubber tube was inserted



FIG 6—After operation

for better drainage This was removed June 4 June 8 the outer angle of the wound was opened and another rubber tube was inserted The exudate gradually subsided permitting removal of the rubber tubes June 16 July 19 an operation was done for repair of the harelip Her recovery was satisfactory August 2, X-ray examination after a barium meal demonstrated the presence of the stomach and large intestine in the abdomen, the left diaphragm apparently intact (Figs 5 and 6)

The field of inquiry involved in this case includes first, the significance of harelip associated with hernia of the diaphragm caused by external violence, second, the size of the tear extending completely across the leaf of the diaphragm, third, the mechanism by which the hernia was produced, fourth, the advantages of a direct transthoracic approach, fifth, the advantage of the two-stage operation during convalescence where a acute intestinal obstruction was not a factor, and sixth, the somewhat surprising ability of the suture line to hold in the presence of an acute suppurative pleuritis Perhaps the most important among these considerations is the mechanism by which this hernia developed



FIG 7—Experimental hernia of left diaphragm Opening in the diaphragm closed Thoracotomy wound closed Lipiodol in both lungs Barium in stomach and colon

The appearance of the tissues adjacent to the oesophagus furnished conclusive evidence that a congenital hernia had existed prior to the accident, upon the hypothesis that the aperture admitted the cardiac portion of the stomach into an area above the diaphragm, that a blow from one part of the automobile severe enough to fracture the femur was probably of sufficient force from another part of the car to produce a sudden violent pressure upon a stomach partly herniated and probably distended Under such circumstances it is easy to conceive that the degree of pressure at the periph-

ery of the existing aperture was more than it was capable of withstanding. So the diaphragm yielded at the point of least resistance. The dimensions of the tear extending to the perimeter of the diaphragm would appear to confirm this theory. If such were the fact and there followed an immediate expulsion of the hollow viscera of the abdomen into the thoracic cavity with collapse of the left lung and displacement of the heart, why did this child not die suddenly? How did she come to survive the shock?

With a view to finding an answer to this question a study of the mechanism of diaphragmatic hernia was conducted in the Laboratory of Surgical Research at the Harvard Medical School. Through the courtesy of Dr. Harvey Cushing and the assistance of the Röntgenological Service at the Peter Bent Brigham Hospital, experiments were carried out upon sixteen dogs and one monkey. The object of the investigation was to study under direct observation the motion of those organs involved in hernia of the diaphragm during the process of its

development. Briefly, the plan consisted of making an artificial opening in the diaphragm, closing it again with a running suture each end of which passed through the abdominal or thoracic wall. The abdominal incision or thoracotomy wound was then closed. The animal was placed on a fluoroscopic table, given a barium meal and a barium enema. The running suture in the experimental opening in the diaphragm was then withdrawn. This allowed



FIG. 8.—Experimental hernia of left diaphragm. Barium in both lungs. Barium in the stomach which is in process of transposition. First stage.

the margins of the aperture to flare open. The movements of the stomach and colon were then observed. This experiment was rendered faulty by the existence of a pneumothorax necessarily following the incision in the dia-

phragm. The monkey and the first two dogs died from asphyxia soon after the withdrawal of the running suture. It was soon found that an animal with a swinging mediastinum or no vertical partition at all succumbed from asphyxia soon after air was permitted to enter the pleural cavity. However, dog No. 3, singularly, survived a sufficient length of time to permit fluoroscopic study of the stomach and colon through the artificial opening in the diaphragm. Attempts to repeat the experiment on other dogs met with failure until we began to use the mechanical respirator of Erlanger. This resulted in a distinct advance toward an ideal setting. We changed from the abdominal approach to the thoracic, thus providing accessibility for making a longer incision through the diaphragm. In addition it permitted control of the desired degree of expansion of the



FIG. 9.—Experimental hernia of left diaphragm. Barium in both lungs. Intrusion of stomach into the pleural cavity. Second stage.

left lung during operation. Closure of the thoracotomy wound was completed while the lung was in a state of complete expansion. One of the dogs regurgitated the barium meal and inhaled a quantity of it. This produced a surprisingly clear shadow of the bronchial tree in each lung (Figs 7 and 8). Although he survived only an hour observations were made under the fluoroscope and recorded at intervals on X-ray films. The following observations were made from the experimental operation

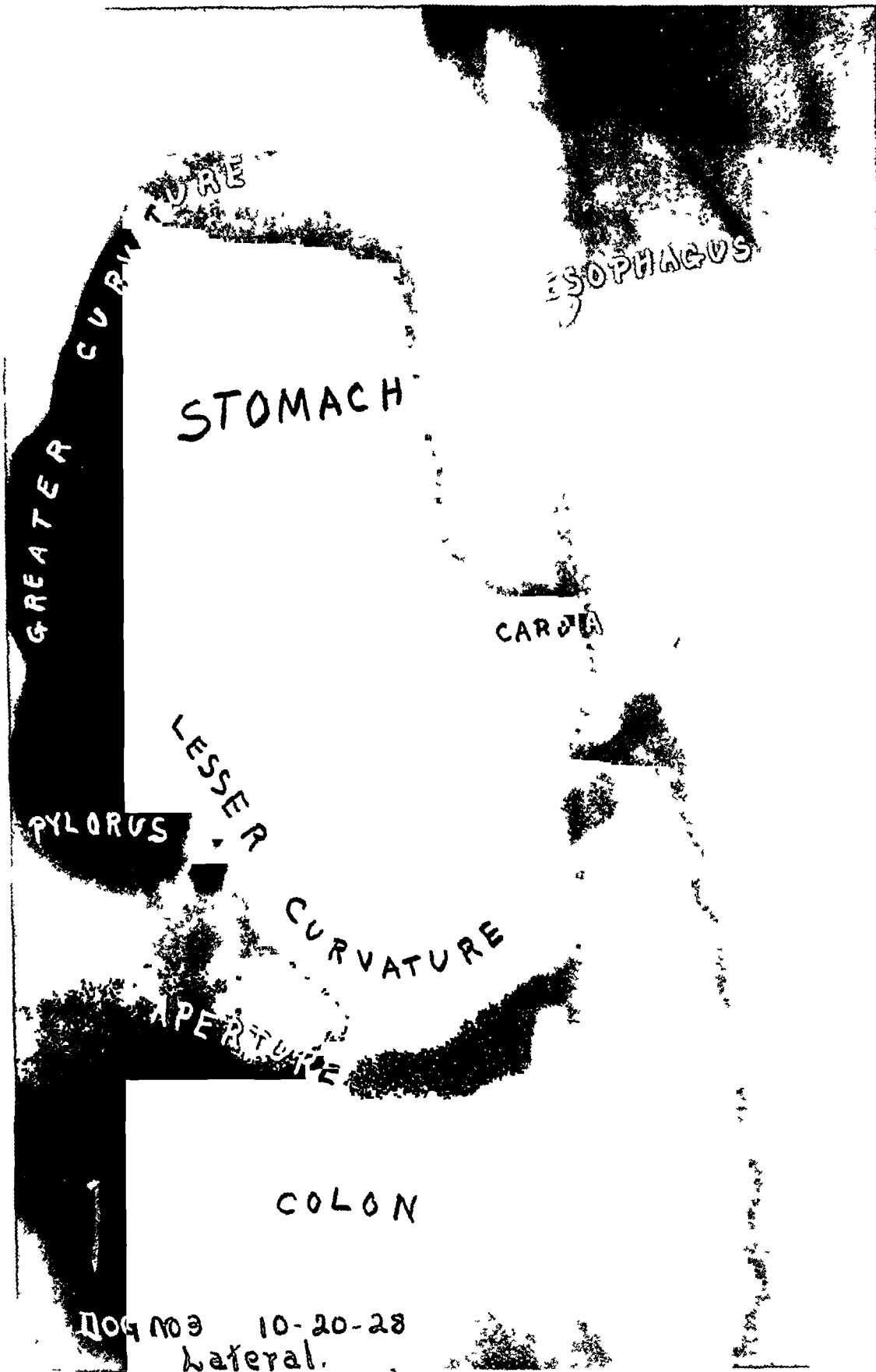


FIG 10 —Experimental hernia of left diaphragm. Intrusion of stomach into the pleural cavity. Final stage. Lateral view.

Immediately after the removal of the controlling suture in the diaphragm the heart moved toward the opposite side. Contraction of the right leaf of the diaphragm during inspiration increased the intra-abdominal pressure and helped force the loosely attached abdominal organs upward. Thus, the stomach made progress in its ascent only during inspiration. The cardiac portion with its greater curvature uppermost entered slowly, changing its position very gradually with each contraction of the right diaphragm. The left leaf of the diaphragm remained almost motionless held by the

advancing stomach and partially paralyzed from severed branches of the phrenic nerve. The larger the amount of barium in the stomach the more its upward displacement was impeded. As the stomach continued its rise above the diaphragm (Fig 8), the greater curvature remained uppermost.

The transverse colon was sharply angulated and followed the stomach through the diaphragmatic opening. The left lung was gradually elevated by the advancing stomach until the bronchi which could be seen were on a horizontal plane (Fig 9). In the final stage the right lung was partially expanding in a cage of reduced dimensions, the major portion of the heart was to the right of the spinal column, the trachea was deflected to the right and the œsophagus arched toward the right by virtue of pressure from the left side on its mediastinal portion and traction on its lower end by the cardiac end of the stomach. The stomach occupied the major portion of the left pleural cavity assuming



FIG 11—Esophagus in normal position. Diaphragm normal.

an inverted position, while the pylorus took an anterior position approaching the level of the diaphragm (Fig 10). The colon was curved upon itself to the outer side of the stomach. Post-mortem examination revealed the left lobe of the liver dipping into the thorax. The omentum followed the colon and loops of small bowel were found at various points above and below the diaphragm. If the opening were too small for the stomach to enter, the omentum would pass through and take with it a portion of the transverse colon. Therefore, the inference seemed plausible that, in the large openings, obstruction would develop only as a result of torsion either of the stomach on its œsophageal attachment or of the intestine from volvulus, the smaller the opening the greater the liability of obstruction of the large intestine from direct impingement of the margins of the aperture upon the lumen of the gut.

CONGENITAL HERNIA AND RUPTURE OF DIAPHRAGM

OBSERVATIONS ON EXPERIMENTAL PHRENICOTOMY

From the appearance of the diaphragm following injury to some of the terminal branches of the phrenic nerve we were led to make a study of the mechanism of the diaphragm following phrenicotomy and its bearing upon that phenomenon, eventration, which has always been classified as a clinical vagary. Our labor was rewarded by disclosing information of practical impor-

tance. Instead of approaching the phrenic nerve through an incision above the clavicle and cutting it as it crosses the scalenus anticus muscle thus leaving an important communicating branch from the brachial plexus, we severed the nerve trunk at a point where it is deflected from the pericardium to the diaphragm on the left side. Fluoroscopic examination showed that the loss of innervation left this side of the diaphragm comparatively motionless. It no longer contracted during inspiration. On the contrary it maintained a somewhat higher level than normal during expiration and during inspiration it went up instead of down (Fig 12). Thus, during respiration after one phrenic nerve was



FIG 12—Left phrenicotomy. Chin in œsophagus. Inspiration. Paralysis of left diaphragm. Deflection of trachea and œsophagus toward the right. Torsion of lower end of œsophagus.

severed, the two sides of the diaphragm exercised an alternating motion, seesawing up and down. Dr M. C. Sosman upon examining the Röntgen-ray films termed this the "paradoxical" action of the diaphragm.

Another effect of phrenicotomy and of more practical significance than eventration was a deformity produced at the lower end of the œsophagus during the period of contraction of the innervated leaf of the diaphragm. There was observed a loss of that well-balanced pull on the lower end of the œsophagus which takes place in the normal diaphragm. The innervated leaf contracting as usual drew the cardiac end of the œsophagus with it. (Fig 13.)

Not only was the œsophagus thus displaced two or three centimeters laterally, but, by the action of the muscle fibers opposing the paralyzed leaf, it was given a rotary motion. In order to study this altered mechanism at this point a rubber tube filled with barium was passed into the stomach. But in addition to being perfectly round this acted as a splint. Thereupon, Dr. Cushing

suggested the use of a metal chain made on a lat pattern (Fig. 11). We found that this served our purpose admirably. While we could not measure accurately the degrees of rotation of the cardiac end of the œsophagus nor the exact distance of lateral displacement, it was apparent that they were circumstances, to produce sufficient, under certain altered function at this segment of the alimentary tract. A case of this sort following an operation for cervical rib came under the observation of Dr. Cushing in which the symptoms were suggestive of cardiospasm.

Two other cases of this "paradoxical action" of the diaphragm have been observed in our clinic. One came under the observation of Dr. George C. King, a baby of two weeks born in



FIG. 13.—Right phrenicotomy. Chain in œsophagus. Inspiration. Paralysis of right diaphragm. Deflection of trachea and œsophagus toward the left. Torsion of lower end of œsophagus.

breech presentation. The extraction of the head was accomplished with difficulty. The infant suffered from attacks of cyanosis and dyspnea. There was an obstetrical paralysis of the right arm. On examination of the chest the percussion note was flat up to the level of the third rib. Respiratory sounds were absent over this area. The X-ray film showed the heart displaced to the left and the liver ostensibly in the right side of the chest. Under the fluoroscope, however, the "paradoxical diaphragm" was demonstrated. The child died four weeks later and the diagnosis of eventration was confirmed at autopsy. Here then was positive evidence of paralysis of the right leaf of the diaphragm with a marked degree of eventration as a concomitant deformity with brachial paralysis. This question seems pertinent. May not this form of phrenic nerve paralysis account for some of the cases of eventration of the diaphragm seen in adult life?

CONGENITAL HERNIA AND RUPTURE OF DIAPHRAGM

Another case of the "paradoxical diaphragm" has been recognized by our Röntgenologist, Dr J H Lindsey. The patient was a woman who, four years previously, had been operated upon for cancer of the breast. She returned on account of vague symptoms of the upper abdomen and chest. An X-ray film revealed paralysis of the left leaf of the diaphragm and evidence of metastasis in the mediastinal glands which apparently was the cause of pressure on the phrenic nerve on the same side.

These experimental and clinical observations are not advanced as a contraindication to phrenicotomy for pulmonary tuberculosis or as a preliminary operation to the repair of those cases of diaphragmatic hernia in which closure of the hernia orifice is expected to be very difficult or otherwise impossible. They bring into notice however the debilitating effect of phrenicotomy on the action of the diaphragm and the associated distortion of the cardiac end of the œsophagus, which in some cases may be the cause of symptoms difficult to explain.

DISCUSSION DR CARL A HEDBLOW, of Chicago, Ill., remarked that in drawing conclusions with reference to the human intrathoracic pressure changes from experimental observations on the dog, one must take cognizance of the fact that in the human the normal mediastinum possesses a much greater degree of stability than that of the dog. Second, that paralysis of the diaphragm seems to me of no particular advantage in the repair of a hernia at the œsophageal ring, inasmuch as there is little or no mobility of the diaphragm in this region. In case of a traumatic rupture in or near its central portion a temporary paralysis is of great advantage and can be achieved by simply crushing the nerve in the neck with a pair of hemostats.

Paralysis of the diaphragm by phrenic nerve resection or extraction has in recent years found a very extensive field of usefulness, particularly in the treatment of pulmonary tuberculosis. I have never seen or heard of any serious detrimental effect of such paralysis of the diaphragm.

DR EMIL GOETSCH, of Brooklyn, New York, related the case of a child seven or eight years of age, who had been knocked down by an automobile. Immediately after the injury there was remarkably little complaint. The child said she had a little pain in the side but that was about all. She was kept out of school for two or three days and soon returned. She went on, and for the following year and a half she had pain only while playing. After that she said she had a "sideache." That was really all she complained of.

The symptom continued. She came to the medical clinic at the hospital and by a simple routine examination a marked dextrocardia was found. Not because the patient was in a bad condition but because of the dextrocardia she was taken to the hospital for further study. There the barium enema revealed most of the colon in the left thorax. Then, further studies with barium by mouth showed the stomach to be there too.

The operation in this instance was a left thoracotomy without cutting the ribs, simply a spreading of the ribs by a mechanical spreader. The operation itself was carried out relatively easily. The ribs were retracted and a large rent was found extending from the periphery of the diaphragm to the peri-

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cardium The phrenic nerve was clearly visible It was not torn because of the accident, but it was reflected to the pericardium and the diaphragm

In closing the opening he freshened the edges of the wound because they were clearly glistening, like the peritoneum and he thought that when he brought them together there might be no healing He therefore refreshed the edges and freed the pleura and peritoneum, closed them with catgut and reinforced with fine silk The wound margins were brought together by a silk suture around the ribs and an airtight closure was made The lung was collapsed Following the operation there was a pleural effusion but the pleural fluid soon was absorbed and the lung expanded The function of the left diaphragm rapidly became normal The patient made a wonderful recovery and was found to be in excellent shape very soon after the operation

RESECTION OF RECTUM FOR CANCER AND CONTINUITY RESTORED

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It is not our purpose in this paper to criticize the work of other surgeons or to question the results obtained by them. The following remarks upon rectal cancer are based upon a rather extensive experience in the surgical treatment of this disease. We do not claim any originality in our work. We have availed ourselves of methods described by other surgeons in situations where they served our purpose the best. The best results have been obtained in those patients in whom the tributary lymph nodes have not shown extensive metastatic deposits to the naked eye, to the feel or to microscopic examination. In cases where there is extensive glandular involvement, local recurrence and distant metastasis is prone to occur regardless of how extensive the operation may have been. A better outlook may be expected in those cases where the growth is more localized.

Cancer begins as a localized disease and has varying degrees of rapidity in its spread. This depends chiefly upon the location in which it first develops, its virulency and the amount of defense the patient possesses. It is singular that in two positions where cancer has a tendency to start it spreads slowly and remains local for a long time. Both are positions where surgical attack is difficult, but both represent a type of cancer which runs a slow course and is considered clinically less malignant. Cancer of the œsophagus destroys life by starvation much more frequently than it does by extension of the disease and rarely by metastasis. Cancer of the rectum is very much more easily removed than cancer of the œsophagus and involves a less vital structure.

Because cancer of the rectum tends to remain local for a long time and grows by direct extension of the disease with late metastasis, we are endeavoring to treat the favorable cases by a less extensive resection than is advocated by other surgeons. The advocates of the abdominoperineal operation claim a greater percentage of cures than is obtained by other methods. We do not perform this operation because of the high mortality it has given us. Those cases of cancer of the rectum which are above the cul-de-sac and too high to be removed through the sacral operation are removed through the abdomen, but we simply remove the tumor by a wide excision and leave the patient with a permanent colostomy. We make no effort to remove the entire bowel including the anus.

The intricate network of lymphatics and their wide distribution to the pelvic glands is a great drawback to a block dissection such as is performed for cancer of the tongue or for cancer of the breast. A so-called radical operation for cancer of the rectum would necessitate the removal of all the

pelvic organs, a manifestly impossible operation. When a cancer of the rectum has invaded the prostate or the bladder or has become attached to the pelvic floor and is immovable and fixed, it is considered to be inoperable and a simple colostomy gives an immense amount of relief and prolongation of life.

All the cases which can be felt by digital examination, are below the cul-de-sac and do not involve the anus are operated upon through the sacral route. Every patient with cancer of the rectum is first explored through an abdominal incision. We are not satisfied to resect a rectum below the cul-de-sac without first carefully exploring the abdomen for enlarged glands or liver metastasis.

In the last nine years sixty cases of cancer of the rectum have come under our care. Thirty-four of these cases were men and twenty-six women. In fifteen of these cases it was possible to restore the continuity of the bowel and preserve the action of the sphincter muscle. The first case of this series, a man, is living, well and attending to his occupation nine years after the operation. There is only one case dead, a woman, and she lived for five years after the operation. The others are all in good condition and attending to their daily duties and thus far present no sign of recurrence. Ten of these were operated upon through the sacral route and five through the abdomen.

The majority of our cases, twenty in number, have occurred between the ages of fifty and sixty. The next in frequency, seventeen, were between sixty and seventy, seven were between forty and fifty, five between seventy and eighty, five between thirty-two and forty, five no ages were given and one at the age of twelve. The youngest was twelve years and the oldest seventy-six years of age. In twenty-seven cases the tumor was resected, leaving the patient with a permanent colostomy. In eighteen cases, which were inoperable, a simple colostomy was performed. In fifteen cases in which the tumor was removed, the colostomy was closed and the continuity of the bowel restored. There were thirty-two cases which were operated upon through the sacrum for cancer below the cul-de-sac within reach of the examining finger. All the others, except those where a simple colostomy was performed, were operated upon through the abdomen and five of them had an end-to-end anastomosis performed and the colostomy closed. One of these died from metastasis five years after. The other four are still living, the longest living nine years after the operation. The other ten cases, in all of which the continuity of the bowel was restored, are living and the time which has elapsed since the operation is as follows: One, nine years, one, eight years, four, four years, two, two years, two, seventeen months, two others, in the hospital at the present time, have had the sigmoid brought down but the colostomy has not yet been closed.

Cancer of the rectum is not a very malignant disease as compared with cancer in other parts of the body. The disease does run a rapid course in some patients but in our series this has not occurred very often. An operation for cancer, regardless of its position in the body, should be made as

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complete as the exigencies of the case will allow. The lymphatics and the lymph glands which are likely to become involved in the extension of the disease should be accurately known. It is impossible to consider any operation for cancer a radical one, since the term implies a complete removal of every cancer cell and this, for obvious reasons, cannot be positively ascertained. The advocates of the abdominoperineal operation, with its attending high operative mortality, make the claim that this procedure, because of its extensive removal of tissue, offers a better chance for a cure than any other form of operation. The German statistics give the mortality rate of the abdominoperineal operation as 50 per cent, while the sacral route claims a mortality of 25 per cent. Jones gives a mortality of the abdominoperineal route as 23 per cent. Of the sixty cases of cancer of the rectum which we have operated upon there were only seven cases in which this method was employed and four of them died within a few days after the operation. The other fifty-three cases, which were operated upon by a preliminary colostomy followed by a sacral operation where the cancer was situated below the cul-de-sac and by a high operation where the growth was above the cul-de-sac, gave a mortality of not more than 12 per cent. We think it is generally conceded that an operation through the sacrum after a preliminary colostomy has a much lower operative death rate than any other form of operation. The best cases, in which it is possible to restore the continuity of the bowel, are those in which the cancer is located below the cul-de-sac and sufficiently far above the sphincter not to involve the lymphatics which go to the glands in Scarpa's triangle, that is the anus is not involved. Those above the cul-de-sac are best operated upon through the abdomen and in five of these cases it was possible to restore the continuity by an end-to-end anastomosis. One of these cases operated upon in 1921, the longest living of this group, is still well. One of these died from metastasis five years after the operation.

The majority of our cases show a comparatively low grade of malignancy. We have seen few instances of the truly annular type of tumor which is not infrequently seen higher up in the intestine. The common picture is that of an apparently slow-growing type of tumor which projects into the lumen of the rectum and becomes secondarily ulcerated and infected. The growth may be limited to one portion of the wall or may have involved the whole circumference. It begins as an indurated, raised area which soon becomes umbilicated and necrotic in the centre with a hard infiltrating margin. It grows much like a ringworm and progresses until it involves the whole circumference of the lining mucous membrane of the rectum. We have observed these cases from a size not much larger than a twenty-five cent piece, through all stages of involvement of the lumen until they finally meet at the periphery. They grow both in the longitudinal and in the lateral direction. They invade the rectal wall and destroy the mucous membrane as they advance. The extent of the invasion of the rectal wall is not easily determined clinically because of the induration due to infection, it must, therefore, be judged from the microscopic section.

Histologically these rectal tumors seem to belong in a group by themselves. Whether one classifies them as adenoma destruens, the term used in Doctor Ewing's book on neoplasms, or by estimating their degree of malignancy by grading according to the method of Broders, makes little difference. The average tumor is made up of groups of irregular glands which closely adhere in general morphology to the original structure of the mucosa. The cells tend to be columnar and comparatively adult in type, often showing the ability to produce mucus. There may be marked variation in the size of the cell and in the distribution of the chromatin within the nuclei. The number of mitotic division figures varies.

These tumors do not show evidence of rapid growth. Thus our series of rectal carcinomata seem to belong to the relatively benign group and might be estimated as belonging to grade two as described by Broders. It has been our experience that such tumors tend to spread mainly by direct extension and do not show the same predisposition to produce apparently isolated growths in the lymph-node metastasis. Doctor Ewing's "Neoplastic Diseases," third edition, page 711, makes the statement, "that metastasis in the adjacent lymph nodes is common in autopsy material but less frequent in operative cases." This would seem to substantiate the contention that in the comparatively early primarily operative cases lymph-node involvement is not the outstanding feature that it is in other types of malignant neoplasm.

Lymphatics—The lymphatics of the colon follow the blood vessels of the mesenteric system. In the rectum the lymph system is more complex. Grota describes four rectal groups:

- 1 The anal vessels form four to five branches which traverse the skin of the perineum and thigh and reach the inguinal nodes in Scarpa's triangle. Other deeper branches join with those of the zona intermedia and reach the anorectal nodes.

- 2 Branches from the zona intermedia pass backward and follow the superior hæmorrhoidal veins to the anorectal nodes but occasionally branches pass to a node at the foramen ischiadicum (Quenu's node).

- 3 Branches from the zona columnaris follow the same course.

- 4 The pars pelvina is drained by vessels which pass below to the anorectal nodes and above to the mesenteric nodes of the colon. Lymph nodes are missing in the wall of the anal portion but are abundant in the fat tissue lying between the muscular wall of the pelvis and intermediate segments and the rectal fascia. In fifty-nine post-mortems collected by Kraske and Iverson, metastases were present in thirty-two—in nodes, liver, peritoneum, lungs and brain. They usually reproduce the original structure. From these data and from the long duration of most cases it is clear that carcinoma of the rectum is a favorable field for aggressive treatment.

A general outline and sequence of the different stages of the operation performed follows:

The operation performed for restoration of the bowel in cancer of the rectum below the cul-de-sac and not involving the anus consists in a median

suprapubic laparotomy with a very careful exploration of the pelvis for glands and peritoneal metastasis in the cul-de-sac. The mobility of the tumor, and its attachments to the surrounding organs such as the prostate, ureter and bladder, should be carefully noted. A thorough exploration of the glands along the external iliac and inferior mesenteric arteries and a careful exploration of the liver should be carried out. The lack of invasion of the lymphatics, peritoneum and liver determine the type of operation to be performed. If, in our judgment, after every condition has been carefully noted, a sacral operation can be performed, a loop of the sigmoid above the sacro-iliac joint and near the descending colon is brought out through a left-sided, gridiron incision, thus leaving the entire sigmoid for mobilization to be brought down and attached to the anus after the removal of the growth has been accomplished. The loop of gut in the left iliac region is opened in forty-eight hours with a cautery.

This we consider the first stage of this operation for the restoration of the continuity of the bowel and it is performed under general anæsthesia in order that complete relaxation may occur and a thorough exploration, visual and manual, may be made. The second stage of this operation is undertaken not earlier than two weeks after the first stage. This allows sufficient time for the colostomy to function well. However, by far the most important point of the delay prior to the second operation is the subsidence of the infection which involves the tumor.

In the performance of the second stage of the operation, sacral or spinal anæsthesia is employed. We have used both and we have come to the conclusion that spinal anæsthesia is preferable. The coccyx with two or three segments of the sacrum is completely removed. We do not believe in an osteoplastic flap. By careful dissection, with as little pushing and tugging as possible, we make a circular dissection of the bowel above the internal sphincter. With the finger hooked around the whole circumference of the bowel, the rectum is divided after a small Payr clamp has been securely fixed to the rectum above the point of division. A cautery may be used to make this division. The upper dissection of the rectum is then started. The rectum is dissected free from the prostate, the ureters are often brought into full view and in the majority of cases the cul-de-sac is opened and the peritoneum divided as it passes from the bladder wall to the rectum and gently and firmly the whole rectum is delivered through the sacral wound. In performing this dissection extreme care is observed not to injure the rectal wall thus allowing the escape into the wound of purulent bloody material rich in cancer cells. All the rectal and areolar tissue in the cavity of the sacrum is removed leaving only the fascia covering the pelvic wall itself. It has been our experience to find indurated adherent glands along both lateral walls of the rectum. We try to keep well outside of this area. The most important consideration is the preservation of the blood supply. Several large rectal arteries which enter the rectum laterally must be severed. It is important to preserve the main branches of the superior hæmorrhoidal artery.

After the whole rectum, including the sigmoid, has been delivered through the sacral wound the bowel is divided well above the tumor and the sigmoid, when all the bleeding has been checked, is brought down, sometimes under considerable tension. As it passes through the dilated sphincter it is attached to the mucocutaneous margin of the anus with interrupted chromic catgut sutures not unlike the Whitehead operation for hæmorrhoids. The wound is only partially closed and is drained with large Penrose tubing packed with iodoform gauze. It would be very fortunate if this union would hold in every case but it seldom does and a second and sometimes a third operation is necessary before the union is complete.

The final operation is not performed earlier than from two to four months after the second. The perineal wound must be entirely closed and the continuity of the bowel must be complete and free from stricture before the colostomy is closed and the bowel contents are allowed to continue their normal course. The operation is difficult, disappointing and trying to the patient but the end sought is worth all the trials and tribulations which both the surgeon and the patient must endure. As has been previously stated there are fifteen patients out of the sixty who have successfully gone through this procedure with but one death, from metastasis, five years later. The patient is ordered to report once every two or three weeks for a few months and a digital examination is made to make certain that no stricture formation occurs. In none of my cases have I observed any growth in the perineum or anal region such as has been described by Miles and it is my belief that the downward extension of the lymphatics which he claims in the normal individual does not exist, but that what happens in fact is an implantation of cancer cells occurring at the time of operation. The lymphatics run mainly in an upward and lateral direction but not downward. In those cases which involve the anus the lymphatics go to Scarpa's triangle. The removal of all the glands along the external iliac artery and the inferior mesenteric in the course of an operation for cancer of the rectum is accomplished with enormous difficulties. The mere fact that these glands are always palpable, are always firm, are always enlarged does not mean that they contain metastases.

In conclusion it is our feeling, judging from the success we have had in this series of cases that it is well worth while to attempt a restoration of the continuity of the bowel more often than has hitherto been attempted. This procedure has a lower operative death rate and the patients are more comfortable and are restored to work. We could have had a larger number to report if many patients had not come so late. So the important criterion in this, as in all other forms of cancer, is early diagnosis.

END RESULTS OF RADICAL OPERATIONS FOR CARCINOMA OF THE RECTUM

By DANIEL FISKE JONES, M D
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UNTIL about fifteen years ago, the physician might well have said that he would not send his patients with carcinoma of the colon and rectum to the surgeon because the results were not good enough and the mortality was too high. While that may have been a legitimate reason at that time, it no longer holds, for the operation has been much improved and the mortality is within reasonable limits. With a disease which would undoubtedly give a high percentage of five-year cures, or even permanent cures if operated upon early, we cannot be satisfied with the interest shown in the diagnosis of these cases by the surgeon or by the physician. It is the duty of the surgeon to stimulate interest in any subject within his province, among the laity and medical profession. It is the duty of the physician to place such diseases among those which he should recognize, and give them the proportionate amount of attention their importance deserves. It is evident at the present time that the physician has not placed a very great importance upon the diagnosis of carcinoma of the colon and rectum, and this applies to many physicians in large hospitals as well as to the family physician. It is rather disturbing to find patients being sent out from hospitals because the X-ray shows no lesion, and in spite of the fact that there is a typical history of cancer of the colon or rectum, or to be told by practicing physicians that they rarely send a case of carcinoma of the colon or rectum to the surgeon, because there is no use in it, or frequently to see patients who have been told that nothing can be done for them. This is a subject which deserves more consideration from the surgeon, and the physician, for it is of much greater frequency than is generally supposed, and is of much greater importance to the patient than many medical conditions upon which much time and effort are spent. It is undoubtedly true that many cases are never seen either by a medical or surgical consultant.

Diagnosis—It is difficult to speak of the diagnosis of a disease which should be diagnosticated, in 100 per cent of the cases presenting themselves. It is true that the patient must first present himself, but this we can expect when more interest is taken in the disease by the profession. The diagnosis is made a complicated procedure by many textbooks which stress late symptoms, while as a matter of fact we should be looking for the very early symptoms. Blood in the stool and any change in bowel habit or sensation are the early symptoms, in fact almost the only symptoms of value at any time, and physicians and patients should be made familiar with them. While any change in bowel habit or sensation is an early symptom, in these days of oils and cathartics little attention is paid to the slight irritation of the

intestine which the growth causes This irritation may result in an increase in the number of movements, a sensation of increased gas in the intestines, or a sensation of inability to empty the intestine Attention to minor details of this sort would put forward the diagnosis of this condition several months Constipation, now recognized as an early symptom, is not present until several months later than formerly because of the use of oils which soften the movement without causing pain It is never an early symptom because the growth must have reached the stage of obstructing the bowel to some extent before it is noted In spite of the use of oils and cathartics, it would be possible to train the laity to recognize the irritative stage of the growth in many cases if interest in the disease could be aroused in the medical profession

Blood in the stool, either macroscopic or microscopic, is undoubtedly a very early symptom and probably the most valuable single symptom we have, in spite of the fact that it is frequently not present A careful search for blood in the stool suggested by any of the early irritative symptoms of the growth would make an early diagnosis possible in many cases Blood is also present with polyps of the colon or rectum, a condition we have come more and more to believe to be of great importance, of even greater importance than carcinoma itself, for polyps frequently become carcinoma, and proper treatment before they become malignant means permanent cure The symptoms of polyps of the colon or rectum are identical with those of early carcinoma

It is unfortunate that at the present time many physicians and every layman believes that hemorrhoids of any kind cause pain and bleeding It is true that internal hemorrhoids do bleed frequently, but it is a much more important fact that carcinomata and polyps bleed It would seem reasonable to expect the medical schools of the country to start students out with this fact uppermost in their minds, rather than with the idea that all bleeding is from hemorrhoids If every physician and every surgeon would determine accurately the location of the source of bleeding by digital and proctoscopic examinations, the operability of cancer of the colon and rectum would be greatly increased and the number of actual cures would be high The removal of polyps alone would undoubtedly save many, probably more than the removal of the early carcinomata If the accurate determination of the source of blood in the stools were attempted, physicians and surgeons would not treat carcinoma for chronic ulcerative colitis for when present the lesions of chronic ulcerative colitis can always be seen through the sigmoidoscope If a normal rectum is seen and blood is seen coming from above, the diagnosis of an ulceration or polyp higher up in the colon can be made, and that ulceration is carcinoma in at least 90 per cent of the cases

The statement has been made frequently that diverticulitis causes bleeding It may be true that diverticulitis in the very acute stage causes a very small amount of bleeding, but for practical purposes diverticulitis does not cause bleeding If after the acute stage has quieted down there is blood in the stool, the diagnosis of carcinoma should always be made

The sigmoidoscope is an instrument still reserved for the specialist to too great an extent. It is a necessary instrument in the diagnosis of diseases of the colon and rectum, and should be used constantly by every internist and surgeon. An efficient instrument for wiping the surface should be added to the equipment, for inability to see the surface of the bowel clearly has led to serious errors.

The diagnosis of carcinoma of the rectum can always be made by digital or sigmoidoscope examination, it is, therefore, useless and often misleading to make an X-ray examination until carcinoma of the rectum has been positively excluded. If no disease sufficient to cause the symptoms is found by the sigmoidoscope, an X-ray examination of the remainder of the colon should be made. A point which may be of value is that polyps and carcinoma are frequently found on the anterior surface of the rectum between fourteen and sixteen centimetres above the external orifice. At this point, there is a fold which it is frequently difficult to get beyond, especially with the patient in the knee-chest position. In the effort to get the instrument over this fold, a polyp or small growth may easily be covered by it. This error can be avoided by making a careful inspection of the whole rectum as the instrument is withdrawn.

As the diagnosis can be made in every case of carcinoma of the rectum by digital and sigmoidoscopic examinations, all that is needed is confirmation by the microscope in a certain small number of cases. Probably the greatest number of mistakes are made in the group of polypoid growths, for it is often impossible to distinguish carcinoma from polyp or *vice versa* by digital, proctoscopic or microscopic examination. If the growth is carcinoma, the malignancy is often found only at the base, from which it is almost impossible to get a section for examination. Recently we have adopted the method of removing the polyp with the high frequency current and then examining the rectum at weekly intervals. If any suspicious area is seen, it is removed with a curette and examined under the microscope. In this way, unnecessarily extensive operations can be avoided, or extensive operations done when malignant disease is found.

Treatment—The treatment of carcinoma of the rectum may be roughly divided into three periods. The first extended up to 1885. During this period, nothing but palliative operations, such as colostomies, section of the sphincter and growth, and curettage were done. The second period extended from 1885 to 1912. Kraske brought out his operation in 1885, but it was too radical for the time and little was done with it for ten years. In 1895, Treves wrote "Excision of the rectum is now a thoroughly established operation and although it met a great deal of opposition in England, it is now pretty generally adopted as the best treatment in selected cases." Selected cases meant 20 to 25 per cent of the cases seen. Many variations on the Kraske operation for excision of the rectum by the posterior route were brought out during this period. The sacral or perineal anus was usually made when the growth was removed. In this period, 25 per cent or less

of the patients seen were operated upon, and from 23 to 28 per cent of those operated upon lived three years

In the third period extending from 1912 to the present time, the abdominoperineal operation has been struggling for recognition Czerny published a paper on an abdominoperineal operation in 1883, but little or no attention was paid to it until Mr Ernest Miles again advocated it in 1912 After a careful study of the lymphatic drainage of the rectum, he was convinced that anatomically at least the combined abdominoperineal operation was the logical one to use, but it met with much opposition in England and has made slow progress everywhere There were three important objections to the operation (1) The permanent colostomy, (2), the immediate mortality was too high, (3), it was a long, tedious, and many times difficult operation

The objections to the colostomy are much exaggerated in the minds of the patient many surgeons and especially the family physician The patient naturally objects when told that there is no voluntary control, and the idea of the bowel emptying itself upon the abdominal wall is revolting He naturally must be made to see the necessity of such a procedure, and should have the backing not only of the surgeon, but particularly of the family physician It is difficult for the surgeon and family physician, who are well, to imagine themselves in any position when such an operation would be necessary Many surgeons and physicians know only the colostomy which is done as a last resort, and the family physician has rarely seen one when the patient has been relieved of the growth in addition to the colostomy Until the surgeon and family physician can be trained to believe that the colostomy is not an impossible burden, we cannot hope to persuade the patient to submit to it To really appreciate the advantages of a colostomy, the patient should be constantly uncomfortable before operation, as most patients with cancer of the rectum are Very few patients with cancer of the rectum would refuse a colostomy if the reasons for it were explained, and if the family physician would join in aiding the surgeon to persuade the patient Unfortunately the family physician too often agrees with the patient that he had better be dead than have a colostomy To answer all arguments against a colostomy, it seems necessary only to state the truth, which is that all patients with a colostomy and removal of the growth live happy and contented lives A colostomy without removal of the growth should not be compared with the comfort a patient gets with a colostomy and removal of the growth Patients with a colostomy alone, not infrequently commit suicide, while we have never had one attempt it who has had a colostomy and removal of the growth The surgeon must be convinced of the value of any operation which requires a colostomy The statistics giving the percentage of patients operated upon and the percentage of patients living three and five years after the various operations should be sufficiently convincing that the combined abdominoperineal operation gives results which justify a colostomy

END RESULTS OF RECTAL CANCER OPERATIONS

Much has been written about colostomies, which give control of the bowel, in fact, the publication of a new operation which will control the bowel after a colostomy is almost as frequent as the presentation of a new model for a needle holder! The only method of controlling the bowel that we know about is to teach the patient how to get the bowels constipated and how to move them once in twenty-four or forty-eight hours, usually without cathartics. To teach the patient to take an interest in his colostomy is the only road to success. No colostomy yet presented will prevent the passage of gas and soft fecal matter. There is little use in discussing the advantages or disadvantages of the colostomy over the perineal or sacral anus as advocated by some Italians. It seems probable that the posterior anus is the choice of the surgeon rather than the patient.

The second objection to the combined operation is the high mortality. This should not be considered too seriously in a disease like carcinoma of the rectum so long as it is kept within reasonable limits, that is, 15 per cent or below. The mortality has been high, up to 50 per cent, but this was during the early days of the operation. One important reason for a high mortality was the attempt to operate upon all patients by this method.

The third objection to the operation, the length and difficulty of it in some cases, must be admitted and only those who are willing to accept these conditions as part of the operation should undertake it.

During the last ten years, many operations have been presented, usually old operations dressed up in new clothes. The resections, and the various posterior operations, are undoubtedly carried out more carefully but the amount of tissue removed is the same, and it is doubtful if the three-and-five-year cures are much greater, although the mortality has been lowered.

The combined abdominoperineal operation in one stage approaches nearest to the ideal operation of any yet presented, in that the growth can be removed wherever situated in the rectum, and it can be removed with the greatest amount of tissue, that is, the greatest area of lymphatic drainage. These facts permit removal of the growth in a greater number of cases and give a higher percentage of three-and-five-year cures than any other operation.

It is unfortunate that surgeons have felt obliged to confine themselves to one operation for cancer of the rectum, for even the combined operation in one stage which permits the removal of any growth anatomically, limits the number of patients operated upon because certain poor risk patients cannot withstand such an extensive procedure. Removal of the growth in every case in which it is possible to do it should be the object of everyone and to do this other operations than the combined abdominoperineal operation in one stage which may be considered the ideal operation to be carried out if possible, must be used. Probably greater harm has been done by this attempt to apply one operation to every case of carcinoma of the rectum than anything else. It is true that an effort should be made to improve the results obtained by the posterior operation, and undoubtedly the combined abdomino-

perineal operation is best suited to it, but poor risk patients should not be neglected because the operation which the surgeon favors is too severe. If we confine ourselves to an operation which can be used even on the feeble, we are not doing justice to those who can stand a more extensive operation. Statistics are now available for nearly all types of operations and the time has passed for presenting small groups of cases operated upon by some method which gives a low mortality in that particular series, or which removes the growth and avoids a colostomy. It must be appreciated by this time that any resection for carcinoma of the rectum, or any posterior excision cannot remove the same amount of tissue or the same amount of lymphatic drainage that the combined abdominoperineal operation does. It may be true that it is useless to remove more than the local growth and the tissue surrounding it, but if that is so, statistics should prove it. Until it has been proved that the extensive removal of bowel and area of lymphatic drainage gives no better percentage of three-year cures than the lesser operations, it is logical to continue to use the more extensive operations in suitable cases. Up to the present time, no series presented gives sufficiently good results to make any operation acceptable as the only operation to be used. Every surgeon who has operated upon cases of carcinoma of the rectum can report a case in which a local excision was done and the patient has lived fourteen years or more, but that does not mean that a reasonable percentage would live three or five years, if a large number of cases were operated upon by that method. While we believe that the combined abdominoperineal operation in one stage is the operation of choice in proper cases, a great error has been made in trying to use it on every patient. It is useless to deny that the operation if used on all cases would give too high a mortality and that would soon have the effect of cutting down the number of patients operated upon and as one of the fundamental principles of the treatment of carcinoma of the rectum should be to remove the growth in every patient when possible, whether a cure can be expected or not, less severe and less extensive operations must be used in addition to the ideal operation. The percentage of patients operated upon and the mortality will depend to a very considerable extent upon the selection of the proper operation for each case, but it should always be remembered that the most extensive operation which the patient will stand should be our object. It is our belief that at least five operations are necessary to make it possible to remove the growth in the greatest possible number of cases.

Next in severity to the combined abdominoperineal operation in one stage is the same operation done in two stages, or the two-stage operation of Coffey. In the combined abdominoperineal operation in two stages, as carried out by the writer, the same dissection is made and the same amount of tissue is removed as in the one-stage operation. A lateral colostomy is made above the point at which the bowel will be sectioned at the second operation. The arches from the left colic artery remain intact to supply the portion of bowel placed below the peritoneal flaps, but the inferior mesenteric

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artery is tied The objection to this operation is that the growth is left *in situ* after the pelvic dissection, until the posterior operation is done a week later It is the operation of choice in high growths in old, feeble and fat patients, especially men It should be the operation of choice no matter where the growth is in patients who can stand it, but who are not quite able to stand the one-stage operation The decision as to whether to make a one- or two-stage operation can be left until just before the peritoneal flaps have been closed over the pelvis, as the blood supply is left intact up to that point Our statistics show nearly as high a percentage of three- and five-year cures by this method as by the single-stage operation, in spite of the apparent objection to it

This operation is too severe for some old, feeble and fat patients with low growths, in such cases the third operation which consists of a colostomy without dissection above, followed in one, two or three weeks by an excision of the rectum by the posterior route should be used While Mummery gives statistics which show nearly as high a percentage of three- and five-year cures as the combined operation, and a much lower mortality, such statistics must require great experience in the selection of cases, for much less tissue is removed

A fourth operation is that presented by William J Mayo in 1912, and recently advocated by Rankin It consists in dissecting the pelvis very much as in the combined abdominoperineal operation to well below the growth The bowel is double clamped and cut across as low as possible in the pelvis The distal end is then closed and the proximal end brought out for a colostomy after removal of the growth, lower portion of the sigmoid, and the greater portion of the rectum This operation is exceedingly useful in high growths in poor risk patients Up to the present time, we have had two cases in which there has been a recurrence in the pelvis with involvement of the remaining portion of the rectum with return of distressing rectal symptoms

A fifth operation is necessary in early and favorable growths situated at a proper height, above the sphincter, to make preservation of it appear to be a reasonable procedure For this operation, we have used the combined abdominoperineal operation in one stage, and have brought the sigmoid down through the sphincter This method has been given preference over a resection and end-to-end suture, because we believe that a greater amount of possibly infected tissue is removed and the section of the bowel below is farther from the growth There is always danger of necrosis because of injury to the blood supply, but there is no danger of fistula as in resections, which is, we believe, as annoying to the patient as a colostomy In the last operation, grading of the growth is of the greatest importance, for a highly malignant one should always be removed by the most extensive operation possible

In the combined operations Whipple has suggested a preliminary cecostomy if there has been much obstruction This would undoubtedly be

a great aid to improving the condition of the patient and would in that way lower the mortality very considerably

It must be evident to anyone doing this work that it is impossible to use the same operation in every case, if we wish to operate upon the greatest possible number of patients. Age, sex, degree of obstruction, variations in the anatomy of the pelvis, amount of retroperitoneal and abdominal fat, the size and position of the growth, the amount of involvement of perirectal tissue and lymphatics, and the general condition of the patient are all so variable, it is unreasonable to depend upon one type of operation. The familiarity of the surgeon with, and his ability to carry out the various operations must have much weight in determining what operation shall be used in any particular case. It is true that there is a standard operation for the great majority of surgical diseases, but if we are to operate upon the greatest possible number of patients with a reasonable mortality and the highest possible percentage of three- and five-year cures, it is impossible to operate upon cases of carcinoma of the rectum by one type of operation.

It must not be forgotten that we still have radium to fall back upon in inoperable cases and in patients too old or too feeble to withstand any of the five operations mentioned above. Radium cannot be used to advantage in many high growths and should not be used in growths close enough to the sphincter to cause a radium burn of it. The pain in such cases is severe and prolonged for months.

In the following tables, we are presenting statistics of a series of cases operated upon in a large teaching hospital, another series operated upon in smaller hospitals with expert assistants. The difference is disturbing, but we have been unable with every effort to make the mortality of the teaching hospital approach that of the private hospital with expert assistants. These patients are frequently quite ill after operation and only the most careful attention by men experienced in this work will detect early, serious symptoms. At the present time, by far the most frequent cause of death is intestinal obstruction. These patients slide very quietly into intestinal obstruction with such unobtrusive symptoms that the condition is often not recognized even by the experienced until it is too late. Peritonitis has almost entirely disappeared, and hæmorrhage is only of secondary importance.

Statistics are of little value unless some uniform scheme for reporting results is adopted. It is particularly true of such conditions as carcinoma of the rectum in which certain operations are of value in only a very small percentage of cases. In a small and well-selected group, the mortality may be low and the number of cases living three and five years high. Up to 1912, less than 25 per cent of the cases seen by surgeons of considerable experience were operated upon. In certain operations advocated at the present time not more than 25 per cent could be operated upon by that method. It is useless to compare the results of a series in which 25 per

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cent are operated upon with those of a series in which 55 per cent are operated upon

The series of cases presented for consideration in this paper includes 285 in which the growth was removed. This is 53 per cent of the cases examined. During the last three years when radium has been used rather more in the advanced cases, and in the very old and feeble, we have performed a radical operation in 47 per cent of the cases examined, radium has been advised in 25 per cent and a colostomy or no operation done in 28 per cent. Seventeen of the cases were treated by various methods. Perineal excision (Harrison-Cripps), resection and suture, local excision, and excision from above with a permanent colostomy. The number in each group is too small to make them of any particular value. Seven cases have not been traced, and are therefore, put into the group of those living less than three years. We have, therefore, a series of 268 cases from which the following tables have been made up. In the following tables, the percentages of those living three and five years were obtained after deducting the immediate mortality. It is of interest to note that in at least 5 per cent of the cases one or more nodules, supposedly metastases, were felt in the liver at the time of operation.

In Table I are given the statistics for all radical operations, both hospital and private cases. The percentages of three- and five-year cases are exclusive of death in the hospital in all the tables.

TABLE I
All Radical Operations

	No cases	Died in hospital per cent	Operated three years +	Per cent living three years	Operated five years	Per cent living five years
Private	136	12.5	90	65.5	77	48
Hospital	132	33	68	66	61	47.5
Private and Hospital	265	22.7	158	66	138	47.8

In Table II are given the mortality and the percentage of cases living three and five years after the combined abdominoperineal operation in one

TABLE II
Combined Abdominoperineal Operation—One and Two Stages

	No cases	Died in hospital per cent	Cases operated three years +	Per cent living	Cases operated five years +	Per cent living
M. G. H. & Private	204	22.7	120	70	103	50
Private	102	11.7	67	71.6	56	53

Combined Abdominoperineal Operation—One Stage

	No cases	Died in hospital per cent	Cases operated three years +	Per cent living	Cases operated five years +	Per cent living
Private	54	5.5	38	78.5	32	56

and two stages and as a comparison the same figures for the combined abdominoperineal operation in one stage done under the best conditions, that is, in private practice. It will be seen that in properly selected cases the mortality in the one-stage operation is not high, and the percentage of three- and five-year cases is considerably higher than by any other operation. This is most gratifying and is conclusive proof, we believe, that the more extensive operation will give better results in those patients who can stand it than in those obtained from more limited operations. These are the statistics which should be compared with those of any other single operation, such as resection and suture, colostomy and posterior excision or any other single operation suggested for removal of cancer of the rectum.

In Table III will be found a comparison of the three important radical operations: the combined abdominoperineal operation in one and two stages

TABLE III
END RESULTS
Abdominoperineal Operation—One Stage

No. cases	Died in hospital per cent	Lived three years + per cent	Lived five years per cent	Untraced
93	17	73	53	2

Abdominoperineal Operation—Two Stages

111	27	68	48	4
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Colostomy and Posterior Excision

61	22.8	50	40	1
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Abdominoperineal Operation in One and Two Stages

204	22.7	70	50	6
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and the colostomy and posterior excision. It will be seen that there is a gradual decrease in the cases living three and five years, from the abdominoperineal operation in one stage to a colostomy and posterior excision which suggests that the more extensive operation gives better results than the posterior excision. This is apparently denied by those who advocate the less extensive type of operation. It would indicate that the more extensive operations should be carried out on those patients who are in sufficiently good condition to withstand the operation.

We are quite agreed with Rankin and some others that the colostomy and posterior excision is the operation of choice for those surgeons who lack experience in selecting proper cases for the more extensive operation. The more experienced the surgeon the more often should he resort to the combined abdominoperineal operation.

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It is interesting to note that forty-three patients who died three or more years after operation died at an average of five years. In sixty-four patients who have lived three or more years and are still living the average duration of life has been seven years. It will, I hope, be seen from these statistics that the radical operation for carcinoma of the rectum has given better results in recent years, and that the operation is well worth the danger and discomfort of it, for we believe that if we can give a patient even one year of comfort the operation has been worth doing. It is evident to all who are doing these operations that if a reasonable amount of interest could be stimulated in the medical profession, operations would be done much earlier, the operative mortality would be lower, and the percentage of five-year cases would be astonishingly high.

DISCUSSION DR CARL A. HAMANN, of Cleveland, Ohio, reported his experience with carcinoma of the rectum. Out of a total of 160 cases eighty-three were operable, an operability of 50 per cent. All those that were removed were adenocarcinoma with two exceptions. One a squamous cell epithelioma, and one a melanosarcoma. In only one case was a Kraske's operation done. In only four cases was the coccyx or any portion of it removed.

The youngest in the number was nineteen. The mortality. In eighty-three operations there were fourteen fatalities, the mortality rate was 14.4 per cent of the operations. There were one Kraske, fourteen combined and sixty-eight perineal operations. No preliminary colostomy was done in any case.

He believed that the psychological effect of an anus in the proper place has a bearing, and he tells a patient that when he gets well his anus will be where it has always been. A great many patients refuse to have an operation when they are told they will have an artificial anus in the iliac region.

The ultimate results were. Of fifty-four patients who were operated on five years or more ago, nineteen are living without recurrence, in other words, there is a five-year cure of 35.2 per cent.

DR WILLY MEYER, of New York City, remarked that patients who have incomplete obstruction can well be prepared without colostomy if one takes the proper time. It may take six to seven days to get the part above the incomplete stricture clear, at least sufficiently clear, as to give no trouble during the operation. Then one can avoid the preliminary opening.

Regarding sudden complete obstruction, he would mention those seen in former times when the X-ray men still used the bismuth meal. In one case where he did a special kind of cecostomy for the second or third time, the patient had come to the hospital without the symptoms of a complete obstruction. The radiographist gave bismuth from above. The result was complete obstruction. Prompt drainage of the colon by cecostomy was indicated.

Cecostomy with a free opening makes the patient most unhappy. The next better is a cecostomy by the infolding method (Witzel), which makes the

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opening water-tight. He used a special method, which he devised for incomplete colonic obstruction. It is done as follows. Sandbag under right hip, McBurney's gridiron incision, removal of the appendix, an oval area of the cæcum is lined with peritoneum and the centre of the piece of gut, thus placed extraperitoneally, after proper packing with gauze, punctured with a small round cautery. A long rubber tube, prepared beforehand with end and two side holes is immediately introduced. It fills the opening completely and is pushed forward into the ascending colon. It is absolutely water-tight from the start. By daily retrograde irrigation, same as is done in a colonic irrigation from below, the gut is gradually emptied.

He had performed this operation in a number of patients to his entire satisfaction and could recommend it. After a few days the smaller tube is exchanged for a larger one for more voluminous retrograde irrigation. Again, it proves to be perfectly water-tight.

During the following radical combined or straight single operation the anterior abdominal wall is ready for aseptic work, particularly in the middle and left side.

After the operation on the large intestine has been done and healing is complete, the tube is removed. The wound then closes spontaneously just as it does in cecostomy after Witzel's method.

Regarding the patients, he referred to two cases where the growth had developed in a place, which the late von Volkmann called "too low to be operated on from above and too high to be operated on from below." Those are the cases where one has to do the combined method. In both his patients obstruction was incomplete. They were, therefore, prepared as mentioned above, without colostomy or cecostomy.

After tying the inferior mesenteric artery, and having loosened the splenic flexure and descending colon through a left perirectal longitudinal incision, the patient was placed in the knee-elbow posture and the operation finished from below.

It is his opinion that it is best for the patient to save the lower stump of the rectum, wherever possible, even if it is only three or four inches long. In this case, the loosened sigmoid and ascending colon could be easily pulled down and, after proper resection of the gut, the closed proximal end of the descending colon drawn through the rectal stump, which had been deprived of its mucosa, without tension. Today, ten years after the operation, the patient has still perfect continence with normal defecation and no recurrence.

The second case was the same as the first with the exception that the tumor was adhering tightly to the posterior surface of the uterus. He did not dare to do an additional extirpation of the latter. He peeled the tumor slowly off the uterus through the left rectus incision and then did the same operation as before. Here a partial gangrene of the lowest part of the sigmoid which had been placed in front of the anus necessitated the establishment of a sacral anus. With the help of prolonged post-operative X-ray treatment the

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patient is alive and well today, after six years, without recurrence Both patients were presented before the New York Surgical Society and the cases reported in the Transactions of the same in the ANNALS OF SURGERY

In a third case of incomplete obstruction at the same level a resection of the pelvic colon with end-to-end suture could be done after preliminary cecostomy, done according to the method described This patient, too, was shown cured before the New York Surgical Society

DR WILLIAM L ESTES, of Bethlehem, Penna, in support of Doctor Verdi's suggestion that many of these cases are not as malignant as they are supposed to be, related an experience with a man who had been thought inoperable Indeed he appeared to have a perfectly inoperable condition The middle section of the rectum was thoroughly involved, and he had almost complete stricture with the periphery of the intestine entirely involved by an indurated ulcerative mass The whole surrounding of the rectum was indurated

He did a colostomy and after six months, or nearly that, the patient came back The induration and adhesions, which formerly had held the rectum firmly against the sacrum and the pelvic contents, were entirely relieved and the tumor with the rectal wall could be freely moved A Kraske operation removed the whole middle section of the rectum After a year he came back and asked if it wouldn't be possible to get rid of the colostomy It didn't leak very much and gave him only a little trouble He did have some odor and occasionally it was more or less disagreeable An opening was made by the sacral route and the upper part of the rectum was brought down and attached to the lower part The man lived fifteen years afterward in perfectly good health, and finally died of a retrosacral lymphosarcoma in the right lumbar region, it had nothing to do with the epithelial tissues Doctor Estes had done this anastomosis in four other cases, all of them from five to nine years ago, and they all had recovered in good condition

DR FREDERIC N G STARR, of Toronto, Canada, remarked that during the course of 1928, he had seen twelve different people who dated their history of ill health to an attack of what had been called "intestinal flu" Upon examination they all had carcinoma of the rectum, the rectosigmoid or the transverse colon

During the past few months he had been very much impressed with two cases in which he did a preliminary cecostomy, a procedure which has an advantage if one contemplates restoring the continuity of the bowel, because one has less tension than if there be a colostomy He also had done the perineal operation, removing the coccyx until the growth was well shown and easily manipulated Then by placing a barrage of radium needles on each side in the levator muscles and a further barrage of radium needles, platinum covered, directly into the growth and leaving them there for a week he had been much impressed at the rapid retrogression of the growth, although he did not know what the ultimate result would be This he is sure of, if

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one feels it necessary to remove the tumor later on it will be a much more simple process than it has been in the past

DR EMMET RIXFORD, of San Francisco, Cal., reported three cases in which local excision of carcinoma of the rectum was done

The first case was a middle aged woman, who came with an evident carcinoma in the rectum, about one by two centimetres in size, situated within easy reach of the finger. The finger could pass well beyond it. After dilating the sphincter with the proper speculum, he drew the tumor down and with a transverse elliptical incision cut it out, closing the wound with transverse suture line. The woman is well today and free of recurrence after twelve years with perfect sphincteric control.

Again he did the same thing for a man who was in almost precisely the same condition. The man is now well and free of recurrence after ten years.

In the third case the local operation should perhaps not have been done. The tumor was more extensive—five centimetres in diameter, the man markedly arteriosclerotic. He recovered from the operation, however, but had recurrence. A second excision was done, but patient died in general breakdown, nineteen months after the last operation—probably, though not demonstrably, with further recurrence.

With reference to polyposis and its relation to carcinoma, he could record a somewhat extraordinary family history of a woman whose grandmother had died of carcinoma of the rectum. All of her four children had polyposis and all died of carcinoma of the rectum. In the third generation there were seven individuals, of which his patient was one, four of them had carcinoma of the rectum presumably with polyposis.

He removed the carcinomatous rectum of this woman with part of the sigmoid—fourteen inches of intestine in all because of multiple polypi. Her two sons had polyposis of the rectum. One of them died of pneumonia at the age of twenty-four and polypi were found at autopsy and the other one died of carcinoma of the rectum at the age of twenty-five. Dr Rixford's patient is alive eighteen years after the excision of the rectum, but her physician reports that she has a palpable tumor in the region of the transverse colon.

DR FRANZ TOREK of New York City called attention to the rule formulated by Doctor Verdi, that in the presence of metastasis in the liver nothing but a colostomy is indicated.

He, himself, had violated that rule in one case not accidentally but intentionally, a case on which he was operating by the combined abdominal perineal method. When he opened the abdomen he found a metastasis in the liver.

However, the man was suffering very much from the foul discharge from his rectum. Besides, an early extension of his carcinoma to the bladder, prostate, and other pelvic tissues would make him still more miserable while at the present stage the tumor was still extirpable.

He proceeded to operate by the combined method. The patient lived a

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comfortable life for a whole year and then died the rather easy death of a patient with carcinoma of the liver

It might be worth while to reconsider the question whether the presence of metastasis in the liver should stand as an absolute and inviolable contra-indication against resection of the rectum for carcinoma as long as the tumor itself is still thoroughly removable

Another point, brought up by Doctor Jones' paper, is the opinion, shared by so many surgeons as to make it appear almost as an axiomatic truth, that if the resection of a patient's rectum involves also the extirpation of his sphincter, he is in a deplorable condition with the perineal anus. That had not been his experience. The important thing is just exactly what Doctor Jones has told in reference to the colostomy wound, that the patient gets along with it very well provided he is instructed to manage it in the proper way, and provided he is kept constipated. If that same rule is followed in the case of a perineal anus the patient will get along just as well.

He had had a number of these cases and if the patient follows the instruction to take a thorough enema every morning, clearing out his rectum and sigmoid, he is free from trouble for the rest of the day.

DR LEWIS L. McARTHUR of Chicago, Ill., endorsed the recommendation of Doctor Verdi that the abdominal incision should be made for the opportunity it gives to determine metastasis, local or elsewhere. If one finds, with the abdomen open—and it is unfortunately true that we do often find—the mesenteric glands in front of the promontory invaded, or in the hollow of the sacrum or nodules in the liver, he should—except in some individual cases where the offensive condition obtains locally—decline to make an extirpation of the tumor, but then and there decide whether the artificial anus shall be permanent or temporary. He related two illustrative cases. One was a case of carcinoma of the rectum requiring exploration first. It required the making of a temporary artificial anus, then the removal of the carcinoma, which could be reached rectally with the finger in the hollow of the sacrum, taking off the coccyx and only a very small portion of the left side of the sacrum.

It was possible to make this excision of the rectum after two weeks from the time of the colostomy. Meanwhile a remarkable effect had resulted from irrigations of the lower segment of the bowel, through the artificial anus, with mercurochrome twice a day. Having resected the tumor and loosened up the bowel above, it was possible to whip the two ends of the bowel together in order to hold them in the position in which future union should be made, the sphincter muscles being preserved. An absolutely primary union was obtained because the bowel, presumably, was absolutely sterile after two weeks of irrigation with 1 per cent mercurochrome. He had never seen it in any other operation in which a single suture of the bowel has been obtained. Having gotten that union, three weeks afterward the artificial opening was closed and that man is in perfect health. This is the fourth

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year since it was done, showing that one can frequently preserve the lower segment

In a similar case in which the artificial anus was made, and no irrigation done, it was impossible to bring the ends together and the upper proximal end was turned in with a silk suture for permanent occlusion, thereby making the artificial anus a permanent one. The upper end of the distal segment was closed with a silk suture and the man abandoned to an artificial anus. After a very stormy convalescence the silk sutures sloughed out and the artificial anus sank in as it does occasionally after the Maydl operation. The patient began passing his faeces through the natural channels after both ends had been closed for permanent closure. He is living and well six years after the operation.

DR J. SHELTON HORSLEY of Richmond, Va., remarked that one objection frequently offered to the combined abdominal perineal method is that there is much shock. All agree that if a block dissection of cancer can be completed in one stage, other things being equal, it is much more desirable than having two stages. The object of the second stage in carcinoma of the rectum, unlike the two stages when there is obstruction of the colon, is not so much to avoid obstruction as it is to avoid death from shock.

If one anticipates this one can start in at the beginning of the operation with a continuous intravenous glucose and Ringer solution and it can be watched by the anaesthetizer or by a nurse and the flow increased or diminished so as to keep the blood pressure and pulse rated at a satisfactory level. Frequently these patients can be carried through a prolonged operation not permitting them to get into the preliminary stages of shock. If, in spite of that, shock comes, a donor should be waiting and transfusion done at once.

By this method a prolonged procedure can be carried on and the operation completed at one stage.

In regard to the cases reported by Doctor Rixford, unfortunately the speaker had had experience that is quite the reverse of his. In a patient on whom, about four years ago, a local operation for carcinoma of the rectum was done, the operation was comparatively easily done. The carcinoma was not of a high grade of malignancy. She returned a few months later with extensive anal recurrence. If a radical operation had been done in the first stage that patient would probably be alive today. Here was a mistaken judgment and an error in doing a local operation on a patient on whom a radical operation should have been done.

While, of course, an artificial anus is not desirable it is much more desirable than death. An abdominal artificial anus is not the extremely objectionable thing that some patients contend. It is better to have an artificial anus that can be kept clean than to have a sentimental perineal anus that cannot be kept clean.

DR HERBERT ALEXANDER BRUCE of Toronto, Canada, spoke of the treatment of inoperable cases by radium. Last year, while attending the International Congress on Cancer in London, he saw a number of cases with Sir

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Charles Gordon Watson who had been using the method practiced by Neumann of Brussels in inoperable cancer of the rectum, which consists in exposing the growth by operation just as if intending to remove it, and then inserting the radium into the growth as well as along the lymphatic spread

In some cases of inoperable cancer of the rectum, in which he had attached the sigmoid to the abdominal wall ready for a colostomy later because obstruction already existed, the radium embedded in the growth was so effective that the obstruction was relieved in the course of a week or ten days, and it was not necessary to complete the colostomy

The results obtained from the use of radium in inoperable cases are so good that one feels justified in employing it rather than condemning the patient to a permanent colostomy

Secondly, in cases where the growth is attached in front to the uterus, the vagina or the prostate, and where it seems clearly inoperable, the use of radium will make it possible later on to remove these growths by surgery

Thirdly, in cases of carcinoma of the anus, which is a squamous-celled carcinoma, he reported excellent results from radium alone

DR WILLIAM F VERDI (in closing the discussion) remarked that in any case of cancer of the rectum a preliminary colostomy is a marvelous help

One of the gentlemen has already spoken of the fact that the possibilities of improvement after this procedure are great With a colostomy established one can wash out the frightfully infected rectum In every case of carcinoma of the rectum that he had seen the tumors were large, fungoid, and sloughing blood, pus, mucus and necrotic tissue If one can get that condition cleaned up one is surprised to see how much one can do afterward

He was in favor of radical operation for cancer He would go as far as possible with any form of cancer, but cancer of the rectum is an entirely different type of cancer The glandular distributions of the rectum are not like they are in cancer of the breast, or cancer of the neck, or cancer of any place where there are definite channels and glands draining the structure that one is about to remove The network of lymphatics in the pelvis all intertwine between the uterus and bladder and rectum so that it really is difficult to do a radical resection in the pelvis for cancer

THE SURGERY OF MEDIASTINAL DERMoids

BASED UPON AN EXPERIENCE WITH FOUR CASES AND A REVIEW
OF THE LITERATURE

By GEORGE J HEUER, M D

OF CINCINNATI, OHIO

It is rather venturesome to discuss the surgery of mediastinal dermoids on the basis of only four cases, but a review of the literature would indicate that in this small series I have met most of the complicating conditions associated with dermoids, such as infection, calcification, hæmorrhage, and communication with a large bronchus, complications which have raised questions as to the proper approach to the lesion, the proper treatment of the lesion when exposed, and the proper method of closure. So, too, I have had some of the post-operative complications which others have experienced, and which in one case led to a fatality which in retrospect might well have been avoided. As a result of my experiences and a review of the literature, I propose in this paper to discuss three aspects of the surgery of mediastinal dermoids (1) The surgical approach to the lesion, (2) the treatment of the lesion when exposed, and (3) the method of closure of the thoracic wound. I shall discuss these three questions in connection with a report of my four cases.

CASE I—The patient, a colored laborer, fifty-three years of age, entered the Johns Hopkins Hospital October 12, 1916. He complained of cough, pain in the right side, and shortness of breath. His family history was unimportant. He had had typhoid fever and pneumonia involving the left lung thirty-two years before, a Neisser infection and a genital lesion thirty years ago but not followed by secondary or tertiary luetic manifestations, and a perforation of his nasal septum, the result of his occupation in an acid factory fifteen years ago. With the exception of pneumonia, he gave on admission no history of symptoms referable to his respiratory tract previous to the onset of his present illness. Questioned since his recovery from operation, however, he states that he now realizes that he had some "misery" in his side and shortness of breath on exertion for an indefinite period. He had been married twice. His first wife died of tuberculosis at the age of thirty-eight. His second wife died two years ago of cancer of the stomach.

Present Illness—One morning, four weeks before admission, while shifting bags of fertilizer, each weighing 300 pounds, he had a sudden severe pain in the right side of his chest, with cough and shortness of breath. The symptoms were so severe that he was compelled to stop work, but was able to walk to a doctor's office. The physician advised rest in bed, and he remained in bed until his admission to the hospital. The cough persisted while the pain and shortness of breath were less troublesome when he was lying quietly in bed.

Physical Examination—He was a very large, well-nourished, muscular man, apparently not seriously ill. The general physical examination, with the exception of that pertaining to his right thorax, was entirely negative. His temperature during the period he was under observation varied between normal and 100°, with an almost daily rise in the afternoon to 99° or 99.2°.

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The right side of the chest on inspection was somewhat flattened over the right upper front. There was diminution in expansion of the entire right side. Vocal fremitus was moderately increased about the apical region in front and behind. It was diminished, but still present, over the lower axillary and subscapular regions. The percussion note and resistance were distinctly increased above the clavicle and over the suprascapular fossa. With the patient in the erect position flatness began at the upper margin of the fifth rib, and in the recumbent position in the middle of the sixth interspace. Behind, the flatness began at the level of the angle of the scapula and continued downward. Beginning just below the level of the line of flatness on the right side there was at least a suggestion of a Grogan's sign on the left. On auscultation the breath sounds were enfeebled at the apex in front and behind. There was an occasional fine bubbling rale on inspiration. Below the line of flatness in front and behind the breath and voice sounds were enfeebled and the vocal resonance was diminished. No pleuritic friction rub was audible.

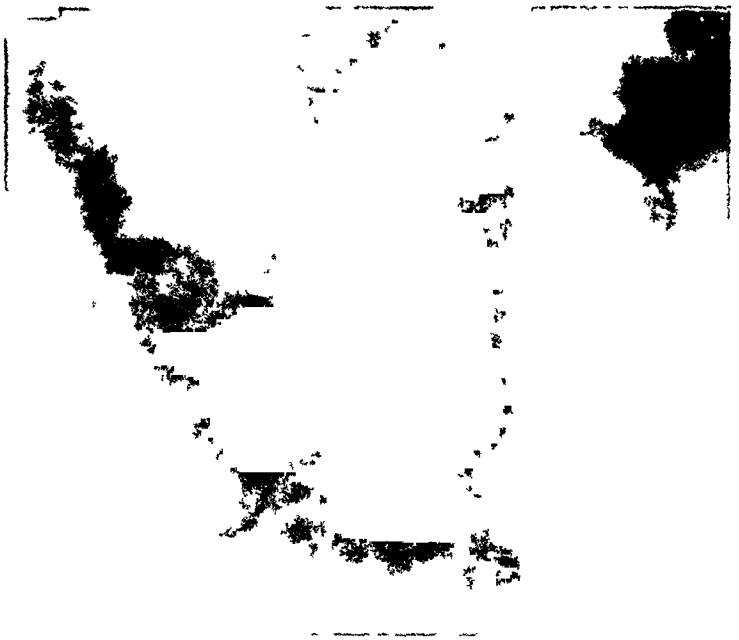


FIG. 1. X-ray of thorax of Case I showing outline of enlarged cyst. Recumbent position. The outline of the cyst has been accentuated.



FIG. 2. X-ray of thorax of Case I, in erect position. The fluid level within the cyst is indicated by the arrow.

The patient was repeatedly examined by various members of the medical staff, and in general the above findings were corroborated. The diagnosis on physical examination alone was a right-sided pleurisy with effusion, of uncertain origin. A thoracentesis was attempted before a roentgenogram had been made. The exploring needle introduced at the eighth interspace behind met with a firm unyielding resistance. No attempt was made to force the needle beyond the obstruction. The procedure resulted in a "dry tap."

Rontgenological Examination — Rontgenograms of the chest explained the cause of the obstruction of the exploring needle and were of the greatest aid in the diagnosis of the condition. The roentgenograms showed in the right thoracic cavity a perfectly circumscribed shadow with remarkably clear outlines. This shadow in general was pyramidal in shape, its base was flattened and rested upon the diaphragm, its apex was rounded and extended 11.5 centimetres

upward into the thoracic cavity. Mesially, the structure was in contact with the mediastinum, laterally it approached to within about one centimetre of the rib margin. The wall of the structure varied from one to 2.5 millimetres in thickness. (Fig. 1) With the patient prone, the contents of this apparently cystic structure cast a shadow of uniform density. In an erect position they separated into two layers, a lower, consisting of fluid and casting a definite shadow, and an upper, consisting of air and represented by an absence of shadow. (Fig. 2)

Close examination of the wall of the structure showed apparently a crack at its upper outer pole. Examined stereoscopically the mass appeared to lie nearer the anterior thoracic wall than the posterior.

Laboratory Findings—Red blood cells 3 552,000, hæmoglobin 60 per cent, white blood cells 7240. Differential count polymorphonuclears 66 per cent, eosinophiles 0.3 per cent, basophiles 0.3 per cent, small mononuclears 13 per cent, large mononuclears 14 per cent, transitionals 6.3 per cent. Wassermann reaction (blood and spinal fluid) was negative. Urine examination showed no abnormalities. Sputum, the daily amount varied. On some occasions during paroxysms of coughing the patient expectorated a cupful of yellowish or reddish-brown seropurulent sputum. It had a slightly foul odor and contained numerous cholesterol crystals, numerous pus and epithelial cells, a few red blood corpuscles, many irregular large and small granular cells containing black pigment dots, and an occasional unidentified structure twenty micra in diameter which when stained proved to be an organism containing an ectosarc and an endosarc and provided with a unipolar group of cilia. Repeated search and digestion studies failed to show hooklets. Hairs were never found and tubercle bacilli could not be demonstrated.

Summary and Discussion—The patient was a man of fifty-three years, who, up to the day of onset of illness, had performed the heaviest labor and was unaware of the condition in his chest until a physical strain gave rise to pain, cough and shortness of breath. He presented the physical signs of pleurisy with effusion. In an attempt to confirm the diagnosis by thoracentesis, the exploratory needle met with resistance such as might be offered by a bony structure. The roentgenograms made possible a diagnosis which could not have been reached by physical examination alone. From these it was evident that there was present a cystic condition with almost complete calcification of the cyst wall, and that the cyst contents consisted of fluid and air. That there was a communication between the cyst and the lung was clinically evident because of the periodic expectoration of large amounts of sputum. The roentgenogram apparently showed this point of communication. Following the roentgenological studies, diagnostic efforts were directed toward establishing the nature of the cystic condition. There was no evidence of tuberculosis, no eosinophilia and no characteristic findings in the sputum, such as hooklets or hairs. Etiologically, there was no history of pulmonary affections, of trauma of the chest or of intimate association with dogs. A positive diagnosis could not be made. The diagnoses suggested were dermoid cyst, encapsulated empyema, hæmatoma of the thorax, and echinococcus cyst.

Operation—November 8, 1916. Under ether anaesthesia, through a long incision, about twenty centimetres of the ninth rib were excised. The parietal pleura was stripped away from the thoracic wall so as to allow satisfactory inspection and palpation of the lesion before opening the pleural cavity. On palpation through the detached pleura, it was at once evident that an extremely hard mass lay directly underneath and was firmly attached to it. A horizontal incision was made through the parietal pleura and the exposed portion of the mass examined. Its presenting surface was whitish in color and of bony hardness. An attempt was made to find a layer of cleavage between it and the parietal pleura, but this was entirely absent over its lateral and anterior aspects. It was necessary to cut across the adhesions with scissors and knife, and after this had been done for a considerable distance in all directions, the anterolateral surface of the cyst was largely exposed.

The operator was a little doubtful how to continue, but having begun to enucleate the mass he kept on with this procedure. As previously noted, it was necessary to cut between the adherent pleura and the outer wall of the mass over its entire anterolateral aspect. Having freed this surface, the operator next explored that in contact with the diaphragm. Here the adhesions became less dense, so that it was easily possible to strip away the diaphragm from the inferior surface of the mass. The operator then explored the mesial wall of the cyst, and found dense adhesions between it and the anterior mediastinum. These were cut with knife or scissors until this aspect of the

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mass was freed. Unfortunately, at the lower mesial aspect of the cyst the operator penetrated its wall, and there followed a discharge of a small amount of a thin, yellowish, purulent material and some air bubbles. The operator packed some gauze into this opening and temporarily left this region. Inserting his hand between the inferior aspect of the mass and the diaphragm, he found the posterior and posteromesial surfaces of the structure could be stripped away from the overlying lung with remarkable ease, so that in a few moments this region was freed from what subsequently proved to be the concave surface of the lower lobe of the lung. The operator then proceeded to free the lateral aspect of the cyst which also was densely adherent to the parietal pleura. The freeing of the upper pole of the mass gave especial trouble and before this was accomplished it seemed necessary to enlarge the operative field by the resection of about fifteen centimetres of the eighth rib.

A narrow strip of lung tissue adherent to the upper pole was cut across and left upon the cyst wall. While freeing this part of the mass there occurred a spontaneous escape of a small quantity of cyst contents and air bubbles and it was assumed that the communication between the cyst and lung was at this point. The last step in the enucleation of the mass was the freeing of its mesial and anterior walls from the mediastinum. It was found that here the bony shell was not complete but was in part formed of dense fibrous tissue. By its division the cyst was opened widely and the major part of its contents escaped. The shell was finally removed *in toto*. There was no hemorrhage through the entire procedure, indeed, it was not necessary to tie a single blood vessel.

After the removal of the mass a very large cavity remained, the inferior surface of which was formed by the diaphragm, the mesial surface by the mediastinum, the upper and posterior surface by the concave surface of the lower lobe of the lung, and the anterolateral surface by the thoracic wall. The right side of the heart lay under the mesial surface of the mass. It was noted that the visceral pleura of the lung in contact with the mass was not thickened. No attempt was made to obliterate the large cavity left after the removal of the mass. It was drained with a single rubber tube. The wound was closed in layers.

Post-operative History—The patient left the operating table in good condition. There were no post-operative complications other than a slight wound infection. For three days the temperature varied between 99.5° and 100.2° and then came to normal. Bismuth injections showed a rapid obliteration of the cavity in the right thorax. By March 1, 1917, the cavity was entirely obliterated, the wound healed and the patient apparently perfectly well. (Fig. 3.)



FIG. 3.—Final result in Case I showing the well healed encircling incision.

Close examination of the wall of the structure showed apparently a crack at its upper outer pole. Examined stereoscopically the mass appeared to lie nearer the anterior thoracic wall than the posterior.

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Pathological Notes—The calcified mass lay within the pleural cavity, not within the lung. The specimen consists of a roughly pyramidal calcified shell which measures



FIG 4—Photograph of specimen of calcified cyst in Case I. Anterolateral aspect

thirteen centimetres in its greatest horizontal diameter, 11.5 centimetres in its greatest vertical height, and seven centimetres in its anteroposterior diameter (Fig 4). Its inferior surface, which rests upon the diaphragm, is flattened and slopes slightly upward and backward, its anterior surface is slightly flattened, while its upper and posterior surfaces are quite spherical. Its wall is complete with the exception of a roughly circular defect about four centimetres in diameter (Fig 5). The anterolateral surface of the shell is roughened and covered by dense fibrous tissue while its apex and posterior curved aspect are perfectly smooth. On examination it is quite evident that the entire shell, with the exception of the defect previously noted, is made up of calcified tissue measuring one to two millimetres in thickness. Its inner surface is roughened and covered by a soft putty-like sediment two to three millimetres in thickness. Microscopic sections show that this sediment is made up of detritus in which no structure which

might give a clue to the nature of the condition can be found. Sections of the wall of the cyst show calcification and not new bone formation.

Studies of the cyst contents and of the sediment failed to establish the nature of the condition, but the presence of cholesterol crystals and cellular detritus strongly suggest a dermoid cyst.

Discussion—Reviewing our own experience, this, from the standpoints of a simple direct approach, of complete removal of the lesion, of satisfactory closure and of short convalescence without deformity at the end, is our most ideal case and one of comparatively few in the literature. In discussing the proper surgical approach to mediastinal dermoids, two groups of cases must be considered, the uncomplicated dermoids and the dermoids complicated by infection. Dermoid cysts may vary greatly in size and may occupy a variety of positions. Duval

has conveniently classified them according to their location into (a) Retrosternal, those not extending beyond the confines of the mediastinum, (b) cervico-retrosternal, those presenting at the base of the neck, in or to one side



FIG 5—Mediastinal aspect of calcified cyst in Case I, showing the defect in the cyst wall. It was here that the cyst was attached to the pericardium.

of the suprasternal notch, (*c*) mediastinothoracic, those extending beyond the confines of the mediastinum into either thoracic cavity, and (*d*) lateral thoracic, those lying largely in either half of the thorax. The uncomplicated dermoids—and by those I mean dermoids without histological or clinical evidence of infectious complications or communication with a large bronchus—may occupy any one of these positions and the proper approach will, therefore, depend upon the size and location of the tumor. A great number of surgical approaches have been described and used which, perhaps I may briefly outline and comment upon.

1 In the cervico-sternal cysts—those small dermoids which lie behind the sternum but project upward into the neck—a simple cervical incision, as in the goitre operation, may suffice. The procedure is carried out as in substernal or intra-thoracic goitre. Five cases in the literature have been successfully approached in this way, in four with total enucleation of the cyst and in one with partial enucleation. In the larger tumors in this location the cervical approach may be combined with resection or division of the upper portion of the sternum, according to the technic of Bardenheuer or Sauerbruch.

2 In the larger retrosternal or mediastino-thoracic tumors a great variety of approaches have been used which roughly may be grouped as follows: (*a*) A single, long, intercostal incision, or one with the resection of a single rib placed at a proper level and exposure obtained by a powerful rib spreader, (*b*) trapdoor approaches of various sorts with pedicles internal, external, superior or inferior, and the object of which is to produce a wide exposure of the thoracic contents which can again be covered by the replacement of the flap. To this group belongs the more recent approach of Kerr who, however, includes a section of the sternum in the trapdoor, (*c*) multiple resections of ribs so as to produce a large defect in the thoracic wall through which the tumor may be delivered. This has been the most common method of approach to the larger dermoids. (*d*) Various forms of sternotomy or division of the sternum, the exposure being obtained by separating the edges of the divided sternum with a rib spreader. These include transverse sternotomy, median and vertical sternotomy, which may be partial and superior or inferior, according to the location of the tumor, or total median sternotomy as first proposed by Milton, and later suggested by Aurousseau, and (*e*) The Tuffier-LeFort approach to the mediastinum which I used in cases III and IV of the following series.

3 In the large lateral thoracic tumors, approaches similar to the preceding groups have been used, but because of the size and the location of the lesions have been restricted to the long intercostal incision or the resection of a single rib, to trapdoor approaches and to multiple rib resections.

To attempt to evaluate all these surgical approaches on the basis of our small experience is difficult, but a consideration of the literature helps us in formulating an opinion. Moreover, the same principles underlying the approach to intrathoracic tumors in general apply to mediastinal dermoids and

in this field we have had a fairly large experience. Certain observations have come from this experience, (a) that air-tight closure of a thoracic wound is highly desirable and even essential, (b) that post-operative infection occasionally occurs following the removal of uncomplicated dermoids as well as other intrathoracic tumors (it occurred in our only uncomplicated case), and (c) that post-operative pleural effusion is a common accompaniment of the removal of intrathoracic tumors, and may become secondarily infected with the development of an empyema. Tension pneumothorax, open, sucking chest wounds and mediastinal and intrapleural infections may, therefore, follow the removal of intrathoracic tumors. From the viewpoints of avoiding or coping successfully with these complications, the approach to the tumor through a long, intercostal incision or one combined with the resection of a single rib is far superior to all the trapdoor approaches, the multiple resections of ribs, the various operations involving the sternum and the approach of Tuffier and LeFort. The points in its favor are that it can be securely and air-tightly closed and it interferes least with the bony framework of the thorax. In our own experience the tumor in Case I was approached through this incision and from the standpoints of exposure of the lesion, closure of the wound, and post-operative complications was the most successful of the series. Cases III and IV, as will be subsequently detailed, were approached through the incision of Tuffier and LeFort, which consists in the resection anteriorly of a single rib with the division near the sternum of the rib cartilages above and below. In one the exposure was difficult and unsatisfactory, in the other very satisfactory. In one a post-operative infection occurred, the wound reopened and a mediastinitis and empyema developed. By good fortune the patient recovered, but the convalescence was greatly prolonged. But had we not avoided in this case the opening of the pleura during the operation, an open, sucking chest wound would have resulted with the almost certain death of the patient. In similar complications when an intercostal incision is used the intrathoracic infection may be drained by means of air-tight suction drainage at some distance from the original incision, with the result that this may heal per primam and the condition resolve itself into the treatment of a simple, closed empyema. We have had this experience. When we review the literature we find many experiences similar to our own. Post-operative infection has been common following the removal of dermoid cysts, presumably due either to errors in technic or to opening what was thought to be an uninfected cyst, or to draining or packing the cavity left after the removal of the cyst. The method of approach has greatly altered the results in the presence of these complications. It has led to death in a number of cases, if not that, has been responsible for a prolonged convalescence with one to many subsequent thoracoplastic procedures to collapse a large infected cavity, or to repeated operations for chondritis or osteomyelitis of divided ribs or sternum. The end result has been a collapsed chest with its unsightly deformity and impaired function. In the literature

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as well as in our own experience a higher percentage of satisfactory results have been obtained with the intercostal incision

We would suggest therefore, that in the approach to uncomplicated dermoids the simple collar incision be used in the small cervico-retrosternal tumors and that the long intercostal incision, or as we like better, the resection of a single rib, be used in the approach to the larger mediastino-thoracic and lateral thoracic tumors whenever possible. Closure should always be securely air-tight and without drainage. In the absence of infections, convalescence is a matter of two weeks with a perfect cosmetic and physiological result, if infection should occur, the problem of treating it is simplified and with the possibility of as satisfactory a result as in acute empyema. In contradistinction the various trapdoor approaches, multiple rib resections, etc., are satisfactory only in the absence of complicating conditions, when such complicating conditions occur, especially infection, they become most unsatisfactory.

The proper treatment of the dermoid when exposed, both from the standpoint of immediate and remote cures and of the avoidance of post-operative complications requires but little discussion. In the treatment of our four cases we invariably made the effort to totally remove the lesion, but we succeeded in only two and failed in two. In one case (infected teratoma) we failed to totally remove the lesion because we could not separate a part of it from the pericardium and feared to persist in the effort because of the danger of pericarditis. In the other case we failed because of the combination of the unusual position of the lesion and the poor exposure. There can be no doubt that radical removal of the tumor is desirable. In a search of the literature and including the four cases above, I have found 138 cases of dermoid cyst of the mediastinum reported. Of these twelve were found at an autopsy in persons dying without the lesion having been diagnosed, eight were diagnosed more or less definitely but the treatment, if any, and the end results are not known, forty-six died untreated and in the majority of cases the diagnosis was established post-mortem, and seventy-two were subjected to operation. Of the seventy-two cases subjected to operation one was treated by simple drainage of the pleural cavity, thirty-four by incision and drainage of the dermoid cyst sometimes with marsupialization, thirteen by incomplete extirpation of the tumor and twenty-four by complete extirpation of the tumor. Of the thirty-four cases treated by incision and drainage nine died within two weeks after operation, four recovered for a time but died as a result of the condition from several weeks to several years after operation, eight recovered but at the time of the last report had persistent fistulas, one recovered but was unimproved, the lesion remaining as before, 5 were cured for from a short period to several years, five recovered but the end result is not stated, and in two cases the outcome of the operation is not given. Of the thirty-four cases, therefore, only five are known to have been completely cured. Of the thirteen cases which died some time after operation

death resulted from sepsis, hæmorrhage or some other complication attributed to the lesion

Of the thirteen cases treated by *incomplete extirpation* of the lesion two died and one was rapidly going down hill from sepsis at the time of the report, four recovered but with draining sinuses, five recovered and were cured from a short time to four years, and one recovered but the end result is not known. In this group pre- and post-operative infections were common, and multiple operations (in one case ten operations) were the rule. Of the twenty-four cases treated by *complete extirpation*, three died and twenty-one recovered. The twenty-one which recovered were cured.

It is evident from this review that complete extirpation, both from the standpoints of mortality and late results, has yielded by far the best results and is the proper treatment whenever possible. Naturally this procedure applies particularly to the uncomplicated dermoids and unquestionably the

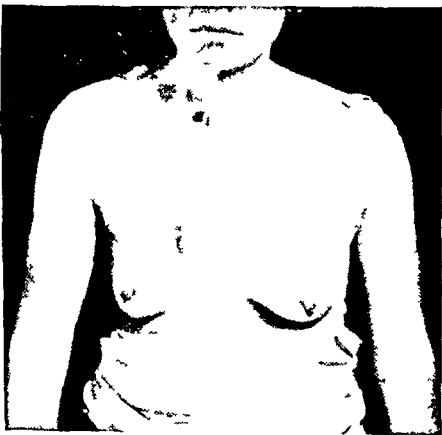


FIG. 6—Photograph of thorax in Case II, showing the anterior discharging sinuses

fact that they were uncomplicated has been responsible in a large measure for the favorable results obtained. When we review the entire series of seventy-two cases subjected to operation we find that twenty-one are known to have died and the majority of these died from infectious complications, a few from hæmorrhage and other complications. It is this fact which has called forth our remarks upon the treatment of infectious complications and methods of approach.

CASE II—A. B., white, female, thirty-nine years of age, was admitted to the Cincinnati General Hospital October 20, 1925, complaining of an intrathoracic tumor and draining sinuses in her neck and right thorax. Early in December, 1921, she developed acute tonsillitis with quite a high fever. About the middle of this month she noticed a small lump or swelling at the base of the neck to the right of the episternal notch, but mesial to the sternomastoid muscle. This area felt rather tense and there was local tenderness. She also had a dull pain in the right apical region of the chest. There was no difficulty in swallowing. There was no cough or expectoration. On January 5, 1922, this swelling, having become more acutely tender, was incised by a physician and a thick, rather cheesy, grayish material, with some hair, was evacuated. Following the drainage of this evident dermoid there was considerable fever so that the patient was compelled to remain in bed. She was ill for some time with fever and pain in her chest, and with considerable loss in weight. A diagnosis of right-sided empyema was made, and on February 22 a rib or ribs were resected just to the right of the sternum. The pleura was opened and pus obtained, which on examination also contained cheesy material and hair. At the same time a rib was resected rather low in the posterior-axillary line upon the right side and pus also obtained here. Drainage tubes were placed through both wounds and following this procedure the patient slowly recovered. Eventually the anterior drainage opening closed. The sinuses in the neck and in the lateral region of the right thorax have continued to drain. She was confined to bed for eight months and her weight dropped to eighty pounds. In November,

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1922, she went to Baltimore and was given one radium treatment at Dr Howard Kelly's Hospital. Between that time and the time of her admission in October, 1925, she had gained in weight and her general condition had improved. The sinuses in her neck and her side have, however, never healed.

Physical examination showed a rather undernourished woman, weighing 115 pounds, with a draining sinus at the root of the neck to the right of the mid-line, and another draining sinus in the right thorax posteriorly. There was a healed scar on the anterior aspect of the right chest just to the right of the sternum (Figs 6, 7 and 8). Examination of the thorax showed the left chest larger than the right with limitation of expansion on the right. The percussion note was markedly impaired over the anterior aspect of the right thorax. Vocal fremitus was diminished and the breath sounds were



FIG 7—Photograph of thorax in Case II, showing the sinus of a chronic empyema

distant. Posteriorly over the right chest the percussion note was much less impaired and the breath sounds nearly normal. No rales were heard on either side of the chest.

In the episternal notch to the right of the mid-line and just medial to the right sternomastoid muscle was a discharging sinus with a ring of granulation tissue about it. This sinus admitted a rubber tube eight millimeters in diameter, which passed down the back of posterior to the clavicle into the right thorax for about two inches. A yellowish-gray, creamy pus exuded from this sinus. Just to the right of the sternum, extending from the third rib down to the level of the lower margin of the sternum was a

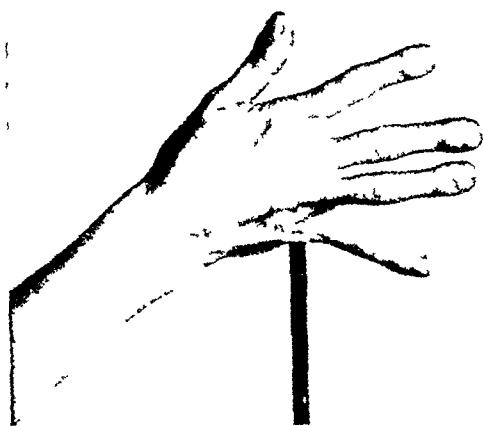


FIG 8—Photograph of hand in Case II, showing clubbing of the fingers

depressed area, 2.5 centimetres wide, in which there was a healed scar. Laterally on the right of the chest low in the posterior-axillary line was another draining sinus which led into the thorax and which also was discharging a thick pus. X-rays of the chest showed a very large mass occupying the anterior mediastinum, extending to either side of the mid-line, but larger upon the right than the left, which fused with the cardiac shadow (Fig 9). Lipiodal injections into the sinuses of the neck and thorax showed a chronic, right-sided empyemic cavity lying in the lower part of the chest. This cavity communicated with what apparently were multiple abscesses within the thoracic tumor. The abscesses within the tumor also connected with the draining sinus in the neck (Fig 10). The diagnosis in view of the history of the discharge of hairs, and in view of the X-ray pictures, was infected dermoid of the mediastinum associated with a chronic empyema and a discharging sinus of the neck.



FIG 9—X ray of the thorax of Case II on admission, showing the large mediastinal shadow. A part of the clouding of the right thorax is due to the thickened pleura, the result of the chronic empyema.

Course—As a preliminary step in the treatment, tubes were introduced into the sinus of the neck and into the empyemic cavity and Carrel-Dakin treatment begun. It seemed desirable to control the infection before making an attempt to remove the



FIG 10—X-ray of the thorax of Case II following a period of Carrel-Dakin treatment of the chronic empyema and after the injection of lipiodol into the external sinuses. The abscesses within the teratoma are shown by the local collections of lipiodol.

mediastinal tumor. Our purpose was to attempt to isolate the tumor from the right thoracic cavity so as to clear up the chronic empyema and to heal, if possible, the sinus in the neck. With this idea in mind, after a period of irrigation, the first step in the operative procedure was carried out, October 1, 1925. A vertical incision was made along the right border of the sternum from a point just below the clavicle to a point just below the inferior end of the sternum. From the upper and lower ends of the incision, counter incisions were carried outward across the chest. A skin muscle flap, including the pectoralis major, was turned outward so as to expose the right border of the sternum and the costal cartilages. The costal cartilages of the second, third, fourth and fifth ribs were resected, in the course of which procedure one of the

branches of the internal mammary artery required ligation (Fig 11). After the resection of these cartilages one could immediately palpate a very firm, solid tumor. After penetrating what appeared to the operator to be the thick, parietal pleura, he was able, by blunt dissection, to outline in part the lateral and inferior borders of the tumor mass. The mass was found to be of great size extending from the clavicle to the lower end of the sternum. It seemed unwise because of the infection and the dense adhesions to attempt at this first stage a removal of the tumor, and the operator determined, therefore, to isolate the tumor from the general pleural cavity on the right and to isolate it from its connection with the sinus in the neck. Therefore he continued to explore and free the right lateral border of the growth until he came upon the connection of the tumor with the chronic empyemic cavity. At this point there was an abscess in the tumor mass containing about an ounce of pus which was evidently draining into the chronic empyemic cavity. This abscess was evacuated and into it was inserted a cigarette drain which was brought forward around the lateral border of the growth. The operator then directed his attention to the superior pole of the tumor which apparently connected with the sinus of the neck.

Having quite satisfactorily surrounded the superior pole of the tumor an incision was made directly across it and there was found a cavity filled with sebaceous and purulent material which connected with the sinus in the neck. In cutting across the superior pole the operator encountered pieces of cartilage and bone and it became at once apparent that he was dealing with a teratoma and not a dermoid. Having cut across the superior pole of the tumor it was possible to bring a drain through the sinus in the neck to the remains of the cavity left after the resection of the upper pole of the mass.

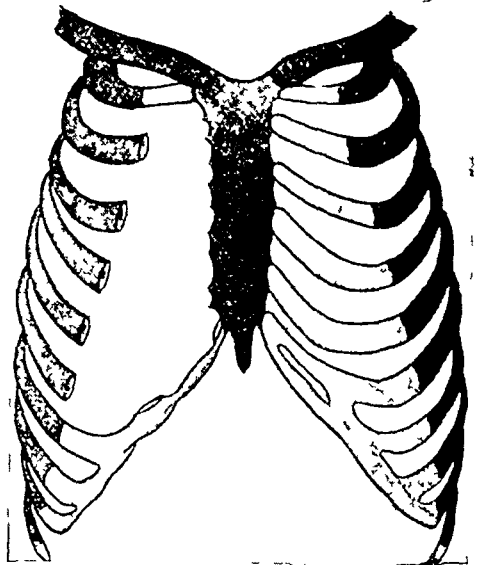


FIG 11—Method of approach to the infected teratoma in Case II.

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As a final step in this first stage the lateral border of the tumor was sutured to the parietal pleura. The skin was partly closed.

The patient recovered satisfactorily from this operation and for a period of several months the chronic empyema cavity was treated by the Carrel-Dakin method as was also the sinus in the neck. Eventually the chronic empyema cavity was completely obliterated and the thoracic sinus closed, as was also the sinus in the neck. The patient, meanwhile, was treated by heliotherapy and gained greatly in weight and strength. As a result, then, of this first stage in the operation we had cured the chronic empyema and had healed the connection between the tumor and the tissues of the neck.

On April 19, 1926, a second stage in the removal of the tumor was undertaken. The old operative scar was excised and the right lateral half of the sternum from the sternoclavicular joint to the xiphoid was rongeured away exposing the medial border of the tumor. An attempt was then made to surround the tumor by blunt dissection. During this manoeuvre several large, bleeding vessels were met with, but were clamped and ligated without any serious loss of blood. The mobilization of the tumor was apparently completed excepting for an area at its lower mesial portion where it was most firmly attached to the pericardium and the great vessels. During our manipulation in this region the patient's condition rather suddenly became precarious, her pulse became very rapid, and she became quite cyanotic. The operation was abandoned, the



FIG. 12.—Result in Case II at the time of the patient's discharge from the hospital. The wound has since closed to a small sinus.

wound being brought together and loosely closed with silk, and the patient given a blood transfusion on the operating table. She made a very prompt recovery and her convalescence proceeded without event. Ten days later the patient was once more operated upon. The wound was reopened and an attempt made to free that portion of the teratoma attached to the pericardium and great vessels. This effort finally was abandoned because it seemed impossible of accomplishment. Moreover, another small abscess within the tumor was opened which might well have caused a pericarditis did we inadvertently open the pericardium. The operator had to be content with carrying an incision through the tumor tissue leaving a layer of the tumor of indefinite thickness attached to the pericardium and great vessels. In the course of sectioning the tumor various structures were encountered, one of which was a piece of bone of the general

shape of a mandible with several teeth and some hair attached. At the completion of the operation it appeared that practically all the tumor had been removed excepting that portion along the pericardium and great vessels. The wound was closed with drainage. At the completion of the operation the patient was given another transfusion of 500 cubic centimetres of blood. Following this procedure the patient again made a very satisfactory recovery and her wound healed fairly rapidly. There developed subsequently, however, a local chondritis about the resected ends of two costal cartilages so that on two subsequent occasions a small operative procedure consisting in the resection and drainage of the infected cartilages was done. The patient was finally discharged with her wound not quite healed. There remained a cavity which led to the tumor tissue along the mediastinum which as time went on became covered with a grayish-white epithelium. With the exception of this small, unhealed area the patient is at the present time, May 1, 1929, perfectly well and has no complaints. She has gained some fifty pounds in weight. Figure 12 shows the present condition.

The examination of the tumor removed shows a typical teratoma. Here and there on section it contains small abscesses as shown in the X-ray plates following lipiodal injections.

Discussion—From a survey of the literature the common complicating conditions present at the time the patient has come under observation have been hæmorrhage and infections of various sorts. Calcification of the cyst wall, as occurred in our first case, has been rare, and aside from increasing the difficulties of the removal of the cyst, or making it impossible to completely extirpate the cyst (one of Tuffier's cases), would not seem to be a serious matter either from the standpoint of the approach or from that of post-operative complications. *Hæmorrhage* from the cyst occurred in one of our cases (Case IV) and has been noted repeatedly in the literature on dermoid cysts. It may be slight and oft repeated, may be moderately severe and produce a serious anæmia, or may be massive and even fatal. At least five cases in the literature died from a massive hæmorrhage from the cyst. Thus far hæmorrhage has not altered surgical procedure except to delay operation until it has been recovered from either naturally or through heliotherapy or by blood transfusion. The massive hæmorrhages which have resulted fatally in a number of cases have as yet presented no surgical aspects. They have been sudden, unexpected and rapidly fatal. Did they happen under favorable conditions surgery might find means of dealing with them.

Infections, then, constitute the important complications which may influence the surgical treatment of dermoid cysts and teratomas. They may involve the cyst alone or they may extend so as to involve the mediastinal structures, the pleura, the tissues of the neck, and the bony thoracic wall. The origin of these infections is not always clear. They have followed respiratory infections, as in one of our cases, and a number in the literature, they have occurred subsequent to the rupture of a cyst into the bronchus, and they have followed incision into or tapping of the cysts. In some of the reported cases it is not apparent how the infection supervened. The results of infections have been intracystic or intrateratoid abscesses, empyemata, abscesses presenting in the neck or chest wall and adhesions to the pleura, to the pericardium and great vessels, and to the tissues of the neck. In the

literature some of these infections or abscesses have extended or perforated into the pericardium, pleura, bronchus, lung or great vessel. Our Case II is a typical, although exaggerated, example of such infections with multiple abscesses within the teratoma, an abscess of the neck and a chronic empyema. In the literature at least ten cases presented a swelling in the neck which was incised by the physician or surgeon, more than twenty cases perforated into a bronchus with a resulting secondary infection in the cyst, some five or six had empyema and an occasional case some other infection, as pericarditis.

In the presence of such infections how shall we proceed, granting we have in mind the attempt to remove the tumor? Shall we proceed at once, as has often been done in the literature, to the removal of the lesion, regardless of the complications which may result, or, shall we first attempt to control the infection before attempting the removal of the lesion? A review of the literature shows that post-operative infectious complications, in part at least due to the existence of pre-operative infections, have altered considerably the immediate results, the convalescence and the eventual physical results. They have been the cause of a number of deaths (about 20 per cent) and they have often resulted in the infection of a large cavity, which in some cases has necessitated multiple thoracoplastic operations over a period of years to finally cure. The result has been a prolonged convalescence with pulmonary impairment and an unsightly deformity. It would appear better, in view of our experiences with Case II, to first attempt to cure the infectious complications such as an abscess of the neck and empyema and to prevent subsequent infectious complications by isolating through adhesions the infected dermoid or teratoma from surrounding structures before attempting the removal of the tumor. To accomplish this may mean, as in our case, a preliminary operation and several months of effort. But the result in Case II would seem to justify the time and effort, for aside from a localized chondritis no post-operative infectious complication occurred, the empyema did not recur and the patient recovered with a lung completely expanded.

With regard to the proper approach to the mediastinal dermoids I have stated that in uncomplicated dermoids the long intercostal incision or one combined with the resection of a single rib is, in our opinion, desirable. When, however, we come to speak of complicated dermoids, meaning by that term dermoids complicated by infection, the method of approach will depend upon the nature and extent of the infection. Two matters come up for consideration, whether the approach will, in the presence of the infection and its accompanying adhesions, permit the exposure and removal of the tumor, and whether it will be likely to result in the spread of the infection, with the possible development of serious post-operative complications. Consider, for example, our Case II, an infected teratoma associated with a chronic empyema. The approach to this lesion through a long intercostal incision (which I have considered ideal for uncomplicated dermoids), either before or after the cure of the chronic empyema, would have meant the wide separation of dense adhesions between lung and parietal pleura and tumor,

which had it been possible, would again have exposed a wide field to infection. It would seem far more desirable to first cure the infection through a preliminary operation and at the same time isolate the tumor from surrounding structures, so as to prevent further infection at its subsequent removal, and having accomplished this to approach the lesion by the local resection of ribs directly over it and remove it through the defect in the thoracic wall thus produced. The failure so to guard against infection has, as I have indicated, often led to death. For dermoids complicated by infection, we would therefore, suggest as a proper approach the local resection of ribs over the tumor, having first cleared up the surrounding infections and isolated the tumor from the surrounding structures.

While complete extirpation of dermoids is the treatment of choice we



FIG 13—X-ray of the thorax in Case III, the arrow points to the lesion

should recognize that it is not always feasible, or at least not always desirable. Tuffier has called attention to this point in reporting a case in which extensive calcification of the cyst made complete removal impossible, and it is particularly in the infected dermoids that it applies. Dermoids may be intimately adherent to the pericardium and to the great vessels in the mediastinum, and in the presence of infection a cleavage plane between them may not be found. It is

quite possible to enter the pericardium, or to tear into a great vessel, with a resulting fatal pericarditis or an alarming or fatal hæmorrhage. In one of the cases of total extirpation in the literature in which the pericardium was opened a brilliant operation was promptly followed by a fatal pericarditis, and other catastrophies have followed the too zealous effort to completely remove the lesion. Both the literature and our own experience with two cases show that with proper handling, and by that I mean careful control of infection and a proper approach, incomplete extirpation may yield very satisfactory results.

CASE III—A white woman, thirty-three years of age, entered the Cincinnati General Hospital January 26, 1928, complaining of shortness of breath and choking sensations. For eleven years she has had shortness of breath on exertion and choking or smothering spells. There was no etiological factor so far as could be determined. More recently, and especially in the past two months, the symptoms have increased in severity so that

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she has become very dyspnoeic. In addition there have been pains through the chest, tenderness on pressure over the sternum, and a dry, hacking, unproductive cough. There has never been any hemoptysis, fever, or loss in weight. Her history otherwise is unimportant.

Physical Examination—A fairly slender, though well-developed white woman, without obvious discomfort. No cyanosis, no enlargement of the superficial vessels about the neck or upper thorax. Examination of the eyes show on the right a typical Horner's syndrome, with ptosis, enophthalmos and contracted pupil. The physical examination otherwise is quite negative. The chest is symmetrical and the respiratory movements equal on the two sides. The examination of the heart and lungs fails to show any abnormalities. Subsequent examinations showed an occasional prolongation of expiration at the right apex and on one examination a friction rub was heard in the region of the fourth rib. The red blood cells were 4,800,000, hæmoglobin 100 per cent, differential count failed to show any gross abnormality, urine negative, Wassermann test negative. The X-ray of the chest showed a tumor mass about the size of an egg lying in the

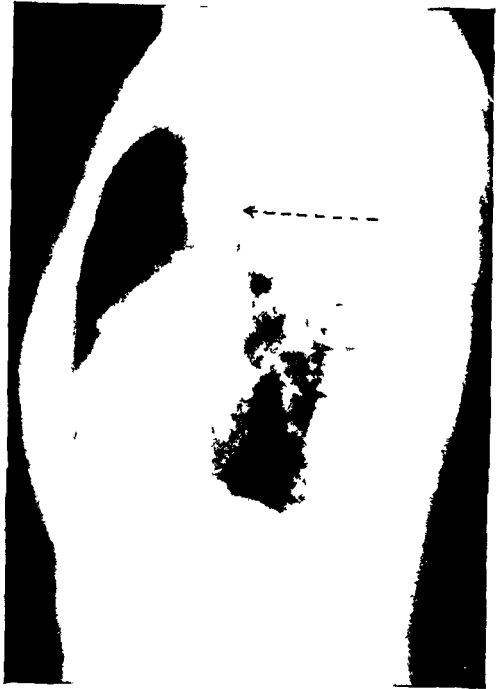


FIG 14—X ray of the thorax in Case III
Lateral view

mediastinum to the right of the midline about opposite to the seventh dorsal vertebra. This mass was very closely outlined as seen in Figs 13 and 14. It was the opinion of the roentgenologist that this was a dermoid cyst.

The diagnosis of mediastinal tumor was made entirely on the X-ray findings, for there were not sufficient physical signs to suggest such a diagnosis. In the absence of any positive findings such as the expectoration of hair, etc., a positive diagnosis of the lesion could not be made. The pre-operative diagnosis was a probable dermoid cyst of the mediastinum.

The operation was performed February 23, 1928, under intratracheal ether anaesthesia. The approach to the lesion was through an incision along the fourth rib on the right side, with the resection of the fourth rib from the sternal margin to the anterior axillary line. A vertical incision was made at right angles to this along the right border of the sternum, and the costal cartilages of

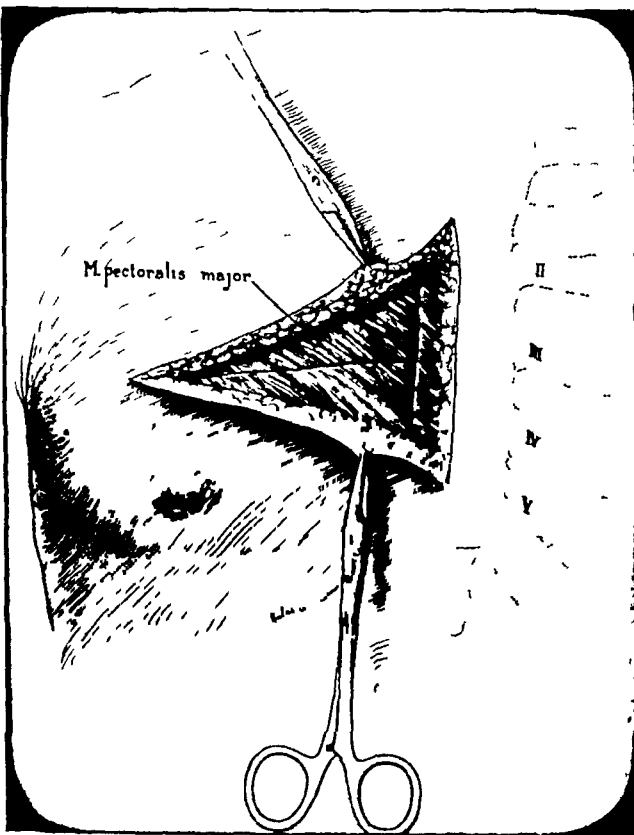


FIG 15—Mediastinal approach to the lesion in Case III
(Tuffier-LeFort). From Keen's "Surgery," vol. VIII

the third and fifth ribs exposed at their junction

approach, Fig 15) These cartilages were divided, but before this was done the parietal pleura was mobilized by stripping it away from the anterior thoracic wall

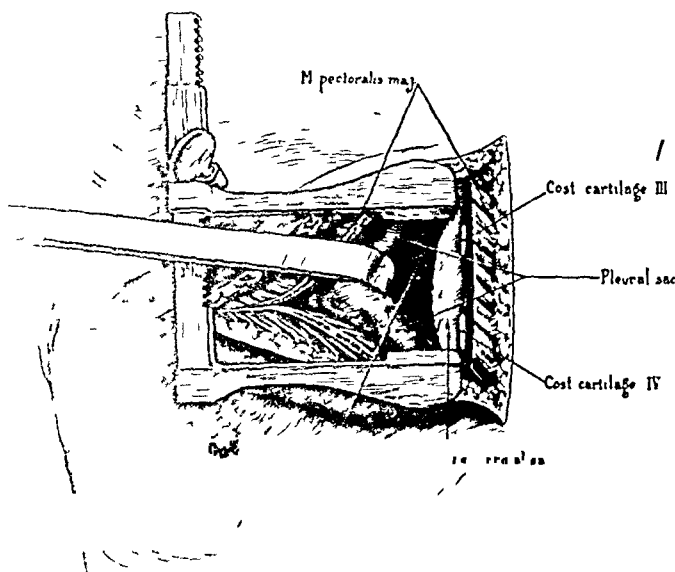


FIG 16—Mediastinal approach to the lesion in Case III. The mediastinal pleura has been mobilized and retracted laterally. From Keen's "Surgery," vol. viii.

A rib spreader was placed in the wound and opened widely so as to give an adequate exposure of the field. The parietal pleura was mobilized further mesially until the mediastinal pleura could be retracted laterally. A fairly satisfactory exposure of the mediastinum could thus be obtained without opening the pleural cavity (Fig 16). The tumor proved to occupy a deeper position than was anticipated. When exposed it was found to lie posterior to the pulmonary vessels and to be crossed by the azygos vein. It was necessary to doubly ligate and divide the azygos vein before the tumor could be satisfactorily freed.

In attempting to completely surround the tumor it was ruptured at one point and a mass of white, cheesy material escaped. No hairs were found in this material on hasty examination. Having ruptured the capsule of the mass, its entire contents were removed with a large gall-bladder scoop. The capsule collapsed following the removal of its contents and was only partially removed. A piece of rubber tubing was placed in the cavity and a couple of cigarette drains placed around the tube. The wound was closed tightly excepting at the point of emergence of the tube and drains.

A microscopic examination of the cheesy material showed it to be made up of detritus, cholesterol crystals and degenerating epithelial cells. No hairs were found.

Post-operative Course—

Following operation there developed a mediastinal infection and then a right empyema. The operative wound partially broke down and had to be more widely opened to secure better drainage of the mediastinum. The empyema was treated by aspiration drainage. The convalescence of the patient was, therefore, much prolonged. The mediastinal and pleural infections,



FIG 17—Post operative X ray of the thorax in Case III. The slight cloudiness of the right thorax is presumably the result of the post operative empyema.

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however, eventually cleared up and the wound completely healed. The patient at the present time, May 1, 1929, is well and free from the subjective symptoms complained of before operation. Post-operative X-rays (Figs 17 and 18) showed the disappearance of the mass.

Discussion—Although the end result in this case was quite satisfactory it seems to confirm some of the statements I have already made. The approach to the lesion was unsatisfactory and the exposure, because of the depth of the wound, inadequate. A transpleural approach through a long incision with the resection of a single rib would have been better. As has been stated in preceding pages infection has not uncommonly followed the removal of uncomplicated as well as complicated dermoids. Whether the infection in the above case was introduced from without or came from the dermoid it is impossible to say, but a perusal of case reports in the literature and our experience with Case II, shows that a dermoid or teratoma wholly unconnected with a bronchus, the lung or other structure may become infected, following acute infections and especially acute respiratory infections. Indeed a dermoid, quiescent and symptomless for years, may become active and provoke symptoms following such infectious conditions, or exacerbations in symptoms already present may follow them. It would appear that latent infections exist in apparently uncomplicated dermoids, and if this is true an approach should be selected with the possibility of post-operative infection in mind.

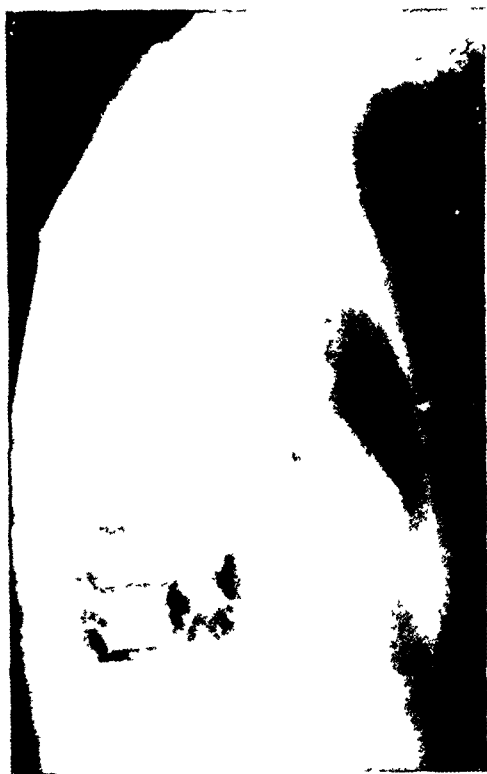


FIG 18.—Post operative X ray of the thorax in Case III. Lateral view. Compare with Fig 14.

The approach we used was unsatisfactory from this point of view, for in the presence of infection the wound broke down principally because of the separation of the divided costal cartilages. The result was a wide open wound, which, had we not been fortunate in not opening the pleura during operation, would have resulted in a large open sucking wound with a pyopneumothorax—a most fatal complication. Even though we escaped this complication we had two distinct conditions to deal with—a suppurative mediastinitis and an empyema, the former of which gave us by far the greater concern. The question arises whether with a transpleural approach an infection originating within the dermoid or during operation would not drain directly into the pleural cavity and give rise to an empyema rather than a spreading mediastinitis. If so, and we favor this idea the problem of infection becomes simpler for not only is the mortality

less but the possibility of dealing with the empyema without the breaking down of the operative wound is greater

The case also supports the statement made in previous pages that incomplete removal of a dermoid may give very satisfactory results

CASE IV—M S, a white woman, twenty-three years of age, was admitted to the Cincinnati General Hospital April 24, 1928, complaining of cough, precordial pain and hemoptysis. The onset of her illness began four years before admission, when, without



FIG 19—Photograph of a fragment of material expectorated by Case IV showing hairs attached

previous cough, expectoration, or other symptoms, she suddenly expectorated about a teaspoonful of bright red blood. She consulted a physician who made a diagnosis of pulmonary tuberculosis. An X-ray of the chest at the time showed a mass which had remained unchanged in all subsequent examinations. About a year after the onset of her illness she coughed up some "yellow clay-like particles which had short yellow hairs attached to them", and since that time she has coughed up similar material three or four times, once in association with a severe hæmorrhage (Fig 19). There had developed a slight, hacking cough with a small amount of mucopurulent sputum which occasionally was blood tinged. For two years she had been unable to breathe comfortably while lying on her back, and for a week before admission she had been markedly short of breath with "smothering spells".

There had been no pain in the chest excepting for a short period of a year before admission, at which time she had sharp, precordial pain accentuated by breathing. There had never been any cyanosis. Palpitation of the heart had been present for the two years previous to admission, but recently had been less marked. There had not been any loss of weight.

Physical examination showed a well-developed and well-nourished white girl, apparently not acutely ill and without any marked discomfort. She was somewhat pale but without cyanosis, pulse, 82, temperature, normal, and respirations, 18 per minute. The thorax was well formed. The left upper thorax appeared slightly fuller than the right and there was definite limitation of motion in this region as compared with the right. Percussion elicited an area of dulness over the left upper thorax in front, but not behind. On auscultation over the left apical region and extending down to the third I S in front, the breath sounds were intensified and roughened and accompanied by many medium, coarse râles. Pressure upon the front of the left chest over the second rib, and extending downward three inches, gave rise to pain and discomfort which was very definite, and quite localized. The examination of the chest otherwise was quite negative. The blood pressure was 110/60. The red cell count

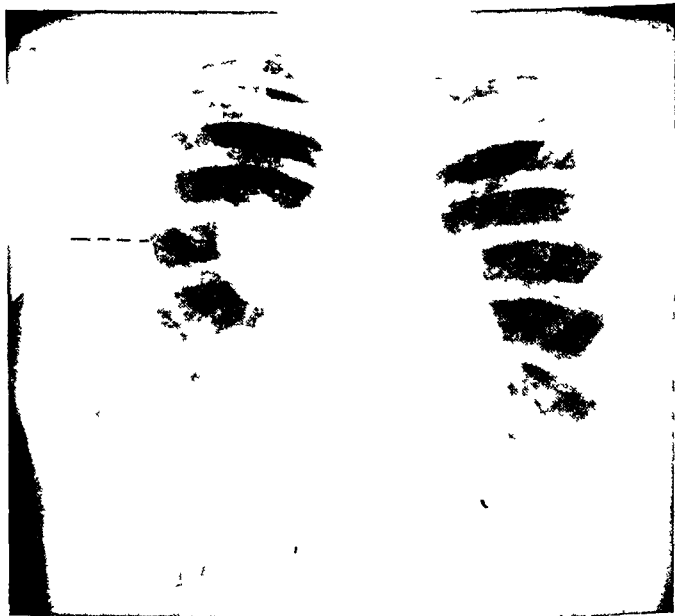


FIG 20—X ray of the thorax in Case IV showing the dermoid cyst projecting into the left thoracic cavity

The blood pressure was 110/60. The red cell count

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was 4,300,000, the hæmoglobin 80 per cent. The white cell count was 9200. The urine was negative. The X-rays of the thorax (Figs 20 and 21) showed a shadow in the left anterior mediastinum about five centimetres in diameter, its mesial border continuous with the mediastinal shadow, its lateral border irregular in outline. The diagnosis of dermoid cyst was made upon the definite finding of hairs and cheesy material in the sputum.

Operation *—April 28, 1928. Under intratracheal anæsthesia an incision was made over the third left rib in front and the rib resected from the lateral border of the sternum to the anterior axillary line. With the finger the underlying pleura was stripped from the chest wall as widely as possible. A short skin incision was then made along the left border of the sternum and at right angles to the first incision and the cartilages of the second and fourth ribs exposed. These were divided transversely where they joined the sternum. A rib spreader was then placed and opened giving a wide triangular field, the base of which was at the sternal border, the apex, in the axilla (Fig 16). The mobilization of the pleura which had not yet been opened was continued mesially so that eventually the mediastinal pleura could be reflected laterally, thereby exposing the left border of pericardium, the great vessels of the mediastinum and the dermoid cyst. The cyst lay as the X-ray showed in the angle formed by the base and the left border of the heart. The freeing of the cyst from the pericardium and great vessels offered no great difficulties and, indeed, the cyst was far less adherent than in any of the previous cases. After it had been accomplished this portion of the cyst was grasped and lifted upward and the lateral borders of the cyst surrounded. It became evident that the communication between the cyst and the bronchus was at the lower lateral pole of the cyst for here the cyst was densely adherent to the lung, and here during our manipulations the pleura was for the first time opened. The opening was temporarily occluded with gauze while the operator cut across the connection between the cyst and lung. On the removal of the cyst the communication between it and the bronchus was found to be large, easily admitting the little finger of the operator. A considerable quantity of heavy, cheesy material was found in the bronchus, having perhaps been squeezed into it during the removal of the cyst. As much of this material as possible was removed. An attempt was made to close the bronchus by an encircling ligature of catgut supplemented by a series of sutures which brought the lung together over it. The rent in the pleura was closed. The wound was closed in layers. The divided costal cartilages were reunited with chromic catgut. Two small cigarette drains were placed extrapleurally down to the neighborhood of the closed bronchus. The skin was closed air-tightly about the drains with silk.

Post-operative—The patient left the operating table in good condition. Three hours after operation she was restless and had severe paroxysms of coughing. Her pulse rose to 130, but was regular, and of good quality. Respirations were regular and normal. Eight hours after operation breathing became shallow and cyanosis appeared. Examination of the wound showed some crepitus in the tissue about it, but no fulness at the root



FIG 21—X ray of the thorax in Case IV
Lateral view

* This case was operated upon before the Society of Clinical Surgery

of the neck to suggest a mediastinal emphysema. The chest was bandaged tightly, oxygen given with a cone, and 750 cubic centimetres of glucose administered intravenously. There was much mucus in the throat which could not be altogether successfully removed. The dyspnoea increasing, a trocar was introduced into the left pleura on the supposition that she had a tension pneumothorax, and connected with a rubber tube, the distal end of which was under water. This failed to relieve the dyspnoea and cyanosis, but some hours later her respirations improved and her cyanosis became less marked. About 4 o'clock the following morning after being apparently greatly improved, she suddenly became cyanotic and her respiration stopped. Efforts at resuscitation were unavailing. An autopsy was not obtained.

Pathology—The specimen consists of a thick walled cyst about 5 centimetres in diameter, partly filled with thick, white cheesy material and abundant blond hairs. The lining of the cyst looks like skin which is thrown into large irregular folds and provided with hair. Microscopic sections show the lining to be made up of typical skin containing hair follicles, sebaceous glands and a few sweat glands. In the loose, areolar tissue beneath the skin are many small lymphocytes and a few polymorphonuclear cells.

Discussion—While the exposure was perfectly satisfactory the attempted extrapleural mediastinal approach proved in the end to have no particular advantage over a transpleural approach, for the pleura was unavoidably opened at the moment that the dermoid was separated from the lung. It is to be noted, however, that the opening of the pleura could have been avoided had we been satisfied to do the operation in two stages, for the dermoid could have been delivered through the thoracic wall and removed at a second sitting. In retrospect our fault probably lay with the treatment of the lesion. Not until after I had removed the cyst did I realize how large was the bronchus with which it communicated. Although it is speculation I think that one or both of two things happened, either the closure of the bronchus was insecure and gave rise to a pneumothorax which was not recognized, or that during the manipulation of the cyst a quantity of the cheesy material within it was squeezed into the bronchus which because of the operation could not be expelled and which occluded the major bronchus. In any event would it not have been wiser, in view of the known communication with a bronchus, to have brought the cyst out through the thoracic wall and removed it at a second sitting?

CONCLUSIONS

From an experience with these four cases of mediastinal dermoid and a survey of the literature I would suggest (1) That in uninfected dermoids the approach be by a long, intercostal incision or one combined with the resection of a single rib. (2) That in infected dermoids or teratomas the approach be such that the infected lesion may be isolated from surrounding structures. The approach by multiple rib resections perhaps best meets this requirement. (3) That in complicated infected dermoids and teratomas it is wiser to attempt to clear up the infection before the removal of the lesion than to chance coping with the infections which may follow the immediate removal of the lesion. (4) That total removal of mediastinal dermoids is undoubtedly the treatment of choice. From the literature it has been fol-

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lowed by the highest percentage of cures with the lowest mortality. These results are, of course, in large part due to the fact that the cases in which this procedure was possible were in greater proportion simple, uninfected or otherwise uncomplicated dermoids. But I wish to point out that complete removal, either because of extensive calcification, infection, or adhesions is not always possible, or if possible, is not always desirable because of the danger of post-operative complications, and that it is better to be content, in certain cases, with less than a complete extirpation, especially since good results may be obtained in this way. The literature contains examples of poor judgment in this respect. (5) That the communication of a dermoid with a large bronchus introduces a factor, which, I think, was responsible for the death of one of my cases. How to deal successfully with the situation I have not yet discovered either from my own experience or from the literature. Should I meet again with it I shall be tempted to deliver the dermoid through the thoracic wall, if that is possible, and remove it after the lung has become adherent to the parietal pleura around the point of communication. (6) That in uninfected dermoids closure of the thoracic wound should be complete and air-tight. In the literature there are many examples of drainage or tamponade of the large cavities left after the removal of the lesions. The results have been unsatisfactory. The cavity has become infected, and, if the patient has survived, multiple thoracoplastic operations have been necessary to obliterate it, the convalescence has been greatly prolonged and an unsightly deformity has resulted. It has been the experience of most observers that a post-operative pleural effusion is a common sequel of tumor removals. This may be treated by aspiration, or, if infected, by continuous air-tight suction drainage. This drainage should be instituted, not through, but far away from the closed thoracic wound, under which circumstances the result may be as satisfactory as in simple empyema.

CONGENITAL MEDIASTINAL CYSTS OF GASTROGENIC AND BRONCHOGENIC ORIGIN

BY CHARLES G MIXTER, M D

AND

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MEDIASTINAL tumors are rarely encountered in childhood. In 1924 Smith and Stone¹ reported two cases from the Children's Hospital of Boston, one of which was a teratoma. They collected from the literature and summarized eight similar cases occurring in children under twelve years of age. Of one

hundred and thirty-nine thoracic dermoids and teratomata collected by Kerr² in 1928, and including his personal case, only eleven occurred in the first decade of life. Recently, three cystic mediastinal tumors have come under our observation that are in a measure comparable to the dermoids, but differ from them histologically. The teratoma is an extremely complex tumor and is composed of tissues derived from all three germinal layers. The der-



FIG 1—Case I. On admission. Diffuse clouding of right side of thorax suggesting pleural effusion.

moid is of simpler structure arising from but two of the three primary embryonal layers. Whereas the dermoid is of ectodermal and mesodermal origin, the tumors we are describing are composed of endothelial and mesothelial derivatives. Two of these cysts are apparently of gastrogenic origin, the third is of bronchogenic derivation. Although the highly differentiated teratomata have been found to contain gastro-intestinal derivatives among other complex structures, we have failed to find mention, in the literature, of the occurrence of the gastrogenic type of cyst of the mediastinum.

CASE I—A white boy, twenty-two months of age, one of six children, was admitted to the Children's Hospital February 20, 1928. The family and past histories were without bearing on the present illness. He had always been well until two months before entry, at which time he was supposed to have had a right-sided pneumonia with a high fever for four days. The temperature then returned to normal and after two weeks in bed the patient was allowed up. During his illness he lost considerable weight.

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Fig 2—Case I After aspiration Shadow running obliquely from hilus to diaphragm on right



Fig 3—Case I Cyst injected after external drainage Shrink age of the cyst has begun





FIG 5—Case I Four months after excision Sinus injected Iodide has flowed back onto chest wall obscuring superficial portion of sinus



FIG 4—Case I Two months after excision of cyst Lung shows considerable expansion

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Present Illness—Four days before entry the patient became ill with fever, dyspnoea and vomiting. After the first day the fever subsided but the vomiting continued. The morning of entry the right ear began to discharge purulent material.

Physical Examination—Temperature 101° , pulse 130, respirations 40–50, weight twenty-one pounds. The child was pale, undeveloped and malnourished, sick and irritable, and could lie only on his right side. He was dyspnoeic with the alae nasi dilating and breathed with an expiratory grunt. There was a frequent harsh, brassy cough. A purulent otitis media was present on the right side. The chest was barrel-shaped with marked costal retraction and with diminished expansion on the right. The right lung was flat, breath sounds were diminished over the greater part, and absent below the angle of the scapula. A few moist râles were present. Tactile fremitus was absent over the right lower back. Bronchial breathing was heard over the right upper chest anteriorly. The heart was displaced two and one-half centimetres outside the left nipple line. The abdomen was protuberant and both spleen and liver were palpable five centimetres below the costal margin. The fingers showed suggestive clubbing.

The X-ray examination suggested fluid, and a tentative diagnosis of empyema was made. Thoracentesis yielded 360 cubic centimetres of a milky, viscid opalescent fluid. The fluid was acid in reaction, its specific gravity 1.010, chloride 114 cubic centimetres neutralized 100 cubic centimetres N/10 NaOH, bicarbonate 34 vol per cent, 560 cells, 80 per cent polymorphonuclears. The withdrawal of the fluid afforded temporary relief of the symptoms. The diffuse clouding of the right chest by X-ray was replaced by a clear lateral lung field and a large, dense shadow running obliquely downward and outward from the hilus. Intratracheal injection of lipiodol through the crico-thyroid membrane gave no diagnostic assistance, though the right upper bronchus failed to fill. The fluid rapidly reaccumulated and repeated tapings were necessary. The child continued to run a low-grade temperature. In view of the character of the fluid and the roentgenological findings, diagnosis of intrathoracic cyst was made.

Operation—March 14. Gas-oxygen anaesthesia. Exploratory thoracotomy. The right upper lobe was atelectatic, rubbery and yellowish-red in color. The two lower lobes were only partially expanded and displaced forward by a large, tense, smooth-walled cyst extending from the diaphragm to the apex of the thorax and filling the spinal gutter. There were no adhesions within the pleural cavity. The cyst was estimated to fill two-thirds of the right thoracic cage. In front it was covered by the visceral pleura which was reflected laterally onto the thoracic wall and mesially along the mediastinum, posterior to the root of the lung. In diameter it appeared to be about two and three-quarter inches at its diaphragmatic attachment, which was retropleural. It was slightly smaller at the apical limit of the tumor which was covered by pleura. The condition of the child did not warrant enucleation at this time. The cyst was sutured to the chest wall and opened six days later and drained by catheter.

The latter procedure was followed by a very severe reaction with a high fever.



FIG. 6—Case I. General condition six months after excision of cyst.

Four transfusions were given at intervals and there was gradual improvement. There were recurrent infections of the cyst cavity, however, with elevation of temperature. There was no gain in weight, but the brassy cough ceased. Repeated X-rays with lipiodol injection demonstrated considerable contraction of the cyst. There was a copious amount of clear white mucoid drainage.

Second Operation—July 23. Gas-oxygen anaesthesia. The old incision was reopened. The seventh rib was excised. The cyst was found to be approximately one-half its

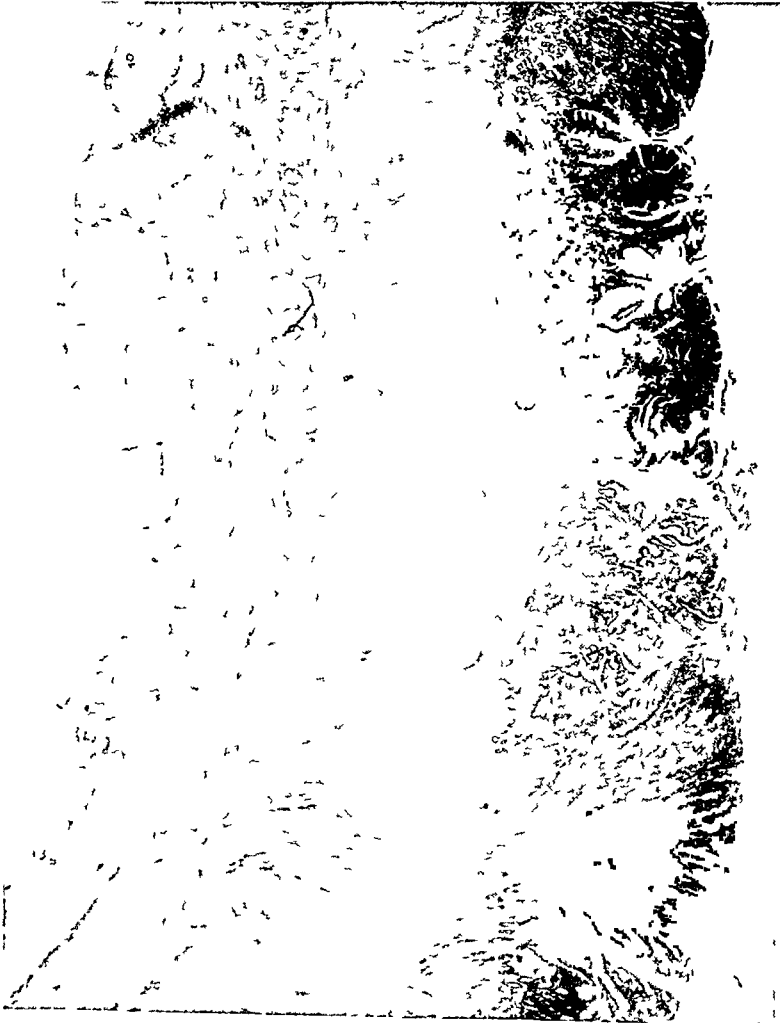


FIG. 7.—Case I. Low power. Mucous membrane, submucosa and two layers of smooth muscle fibres are present.

former size. The wall was greatly thickened and fibrous. The condition of the three lobes of the lung remained the same as at the previous operation. The pleura was incised vertically over the surface of the cyst. No cleavage plane could be found and the cyst was freely opened and with a finger introduced into the cavity the cyst was excised by sharp dissection, including the overlying pleura that could not be detached. The greatest difficulty was encountered in excising the lower end of the tumor where a prolongation appeared to dip down into or through the diaphragm. This prolongation appeared to be about three-eighths inch in

depth and three-fourths inch in diameter. There was relatively little hæmorrhage. A gauze drain was left at either end of the incision to control oozing and the wound was approximated closely about them.

The child's condition was precarious at the end of operation. An intravenous injection of glucose was given followed some hours later by the transfusion of 300 cubic centimetres of blood, following which the child picked up well and made a satisfactory convalescence.

He has been followed for eight months. The wound is now closed except for two small sinuses that discharge the original fluid, presumably from a portion of the cyst remaining. The general condition has shown remarkable improvement, the weight now being twenty-six and one-half pounds.

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Pathological Report—Cyst of mediastinum Specimen consists of three large fragments of tissue and a number of small ones The largest of these are $6 \times 3 \times 1$ cm, $4 \times 2 \times 1$ cm, and $2 \times 1 \times 1$ cm These are composed of very firm grayish-white tissue, with occasional areas which are somewhat nodular on palpation The inner surface is partly covered by blood clot and grayish tissue which has some purulent material over some of the areas In the largest fragment there is noted on the inner surface an elevated area which is a pinkish-gray color and is somewhat soft This area is more or less circumscribed and has a definite margin The appearance of this tissue is that of granulation tissue In none of the fragments was one able to find gross evidence of hair

Microscopic—Six sections, two of which show what is histologically apparently stomach wall They are lined on one side by gastric mucosa, with submucosa, muscularis, mucosa and muscular layers underlying There are numerous Paneth's cells in the mucosa The rugæ are present in some areas with strands of smooth muscle as seen in the normal stomach wall The mucosa is destroyed in places by fibrous tissue, and scattered throughout there are areas of hæmorrhage and cellular infiltration, chiefly polymorphonuclears and plasma cells with many lymphocytes

One section is through a very active lymph gland, showing many hyperplastic follicles and scattered areas of necrosis and perivascular infiltration The remaining three sections show chiefly fibrous tissue with some smooth muscle and fat There is one small area of striated muscle There are scattered areas of necrosis and cellular infiltration and marked perivascular infiltration There are nerve trunks of various sizes in all sections and a portion of a ganglion in one

Diagnosis—Chronic inflammatory tissue Smooth muscle and hyperplastic mucosa, histologically of stomach wall

CASE II—A white, male infant was admitted to the hospital September 14, 1927, at the age of seven weeks, because of distress, especially after nursing

The family history was negative The birth weight was nine and three-quarter pounds From birth he cried a great deal He was unable to nurse longer than five minutes when he would suddenly stop, double up the legs, throw back the head and cry as though in pain The acute distress would continue for about a half hour and prevented the infant from obtaining an adequate amount of sleep On physical examination he was found uncomfortable with paroxysms of crying as though in pain The weight was six ounces more than at birth There was no respiratory distress and the routine physical examination was negative With the exception of a white blood count of 37,000, the laboratory studies were also negative He was in the hospital two weeks and became much more comfortable, gained three ounces, and being breast fed was sent home



FIG 8—Case I High power Typical gastric glands, such as are seen in the fundus of the stomach, with chief and parietal cells present



FIG 9—Case II Before aspiration
Diffuse clouding right upper chest extending across to left of median line



FIG 10—Case II After aspiration
Arrow points to erosion of rib from pressure of cyst



FIG 11—Case II Cyst injected following aspiration Anteroposterior view



FIG 12—Case II Cyst injected following aspiration Lateral view

CONGENITAL MEDIASTINAL CYSTS

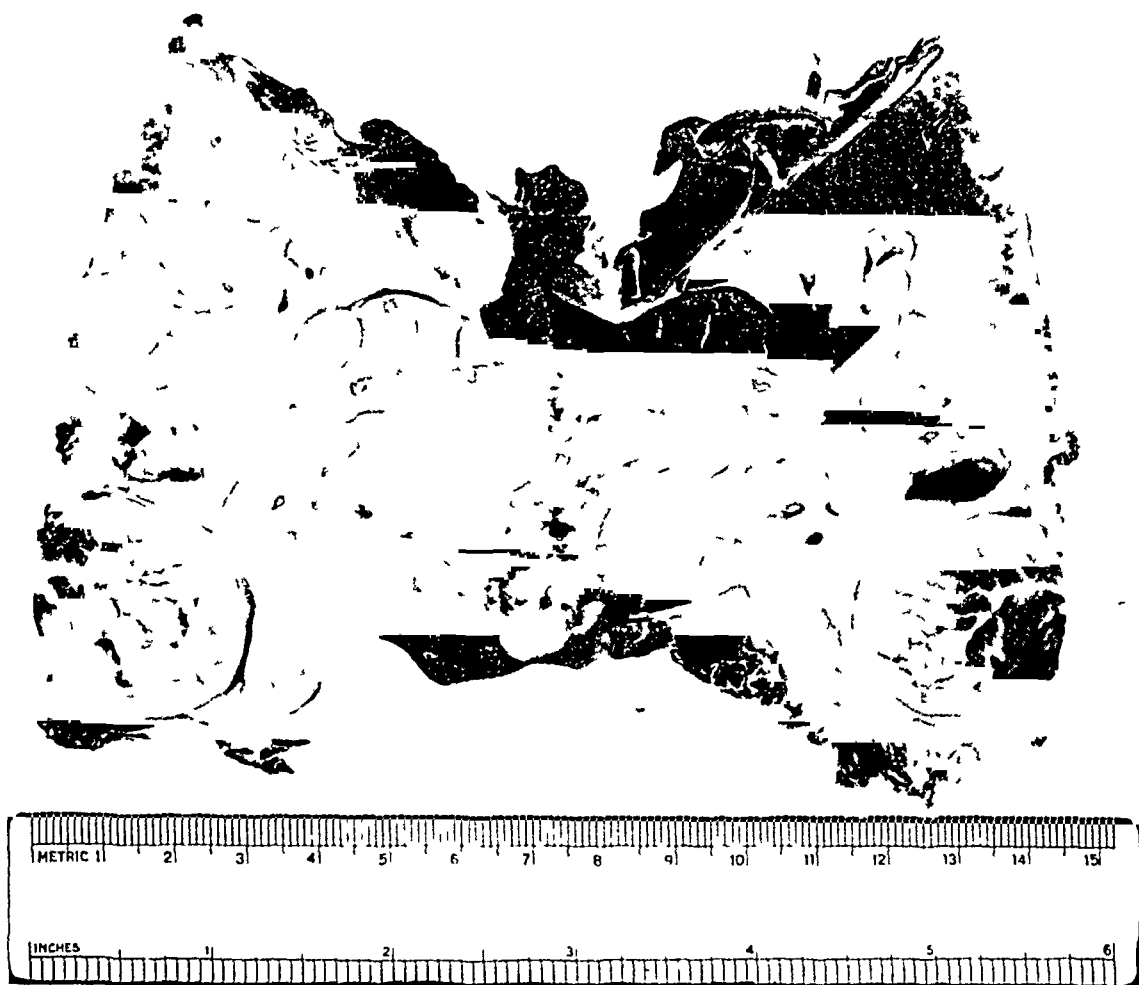


FIG 13—Case II Gross specimen obtained at autopsy Cyst opened, showing mucosa thrown into folds



FIG 14—Case II Low power Mucosa, submucosa, two layers of smooth muscle and serosa are present

One week later he was readmitted with persistence of the original symptoms. The weight was now eleven pounds. Temperature 100.6°, red blood count 3,600,000, hemoglobin 60 per cent, white blood count 21,500, 74 per cent polymorphonuclears. The spinal fluid Wassermann reaction was negative. There was a palpable spleen. Pathology was suspected in the chest and an X-ray showed a "pneumonia of unusual distribution—tuberculosis to be considered." Tuberculin 1-25 was negative. The respirations became more difficult, and the patient began to hold the head retracted. Dulness and bronchial breathing appeared over the right upper chest and X-ray showed an extension of the process and malignant disease was suggested. A barium meal showed that there was no oesophageal obstruction. An area of pressure erosion was found in the region of the angle of the fourth and fifth ribs posteriorly, and thoracentesis was attempted in this area. After penetrating about an inch, a cyst was punctured and fluid under pressure

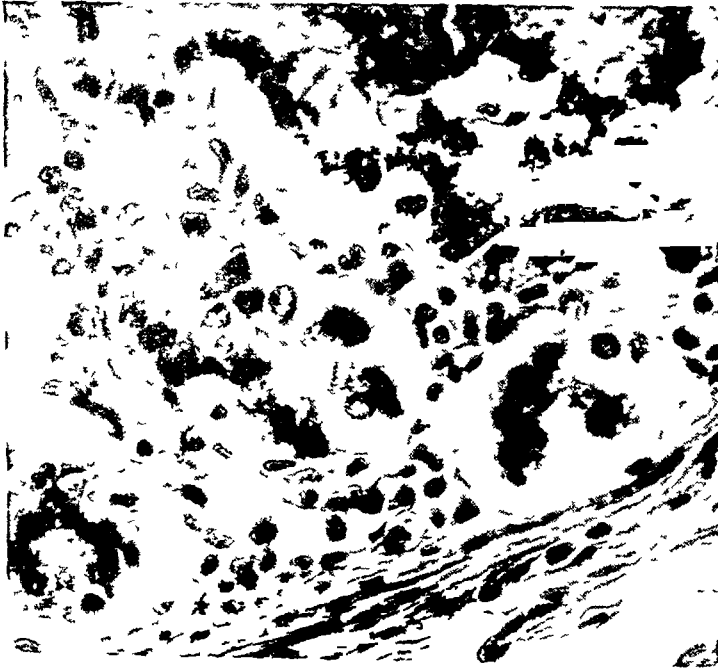


FIG. 15.—Case II. High power. Typical gastric gland structure present with chief and parietal cells.

oesophagus, and displacing them forward and extending laterally behind the lung toward both apices.

At seven months his weight was the same as at birth. He had developed a very loose, brassy cough and on several occasions coughed up considerable amounts of blood. A month later an unsuccessful attempt to find the cyst surgically was made, and two weeks later a second attempt to approach the cyst surgically failed. The patient's general condition seemed stationary and he was sent home June 4, 1928, at the age of ten months, weighing ten and one-half pounds.

Three months later he was readmitted for the third time, in the hope that the cyst had filled up to the point where it could be enucleated surgically. His weight was now eleven pounds and the general symptoms were the same as before. The head was held in marked retraction, the fingers now were definitely clubbed. A thoracentesis failed to enter the cyst and so no further surgical exploration was attempted.

The patient was in the hospital four months, failed to gain, had several exacerbations of a chronic pneumonia and finally died of bronchopneumonia at the age of sixteen months, weighing ten and one-quarter pounds.

The findings at post-mortem were as follows:

nearly shot the plunger out of the syringe. The fluid was thick, viscid, mucoid, and contained 700 cells, mostly red blood cells, with a moderate number of lymphocytes. No organisms, hairs or epithelial cells were seen. Having demonstrated a cystic cavity, a second tap was attempted and thirty-five cubic centimetres of similar fluid under pressure was removed, the last five cubic centimetres of which was mixed with old blood, and eight cubic centimetres of lipiodol was injected. The X-ray showed a large multilocular cystic cavity posterior to the trachea and

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The tumor mass was found attached in part to the apex of the right lung by fibrous tissue, while the remaining tumor mass was separated from the lung by a serous membrane which covers part of the lung and wall of the cyst, forming a definite serous cavity. The entire tumor mass was found to be five centimetres in diameter and was composed of two portions, one of which at this time was a thin, fibrous, cystic mass which extended into a cavity which had been formed by the erosion of the bodies of the vertebræ and in part involved a portion of the adjacent ribs. The second portion of this cavity communicated with the previously-mentioned portion of the cyst by two small openings. The second portion of the cyst was composed of what in the gross appears to be a portion of gastro-intestinal tract, the mucosa of which has numerous folds, a definite submucosa, several layers of smooth muscle and a serosa, the latter covering a portion of the second lobule of the cystic mass. These cystic structures do not appear to be associated or directly connected with the trachea, œsophagus or bronchi, it appearing as an isolated structure, partially attached to the apex of the lung.

Microscopically — The mucosa lining the second portion of the cyst is composed of deep branching glands, the cells of which are of a mixed type, being composed of parietal and chief cells. The smooth muscle assumes an orderly arrangement and there is present a serosa such as one finds in a normal gastro-intestinal tract.

CASE III—A white female, three months of age, was admitted May 27, 1927, with the history of cyanotic attacks for two months.

The family history was negative. The birth weight was eight pounds. There was no convulsion or cyanosis immediately following birth.

Present Illness—From birth the baby breathed with a distinct wheezing sound which had become more noticeable. At one month attacks of cyanosis set in, lasting a minute or so. These increased in frequency, five attacks having occurred the day before entry. They appeared to be induced by crying or eating.

Physical Examination—A well-developed and nourished child crying in distress, and extremely dyspnoic. The dyspnoea was of the expiratory type as though there was a valve closure after inspiration. The breathing sounded asthmatic. There was an extreme expiratory grunt. The pharynx and upper respiratory passages were clear.

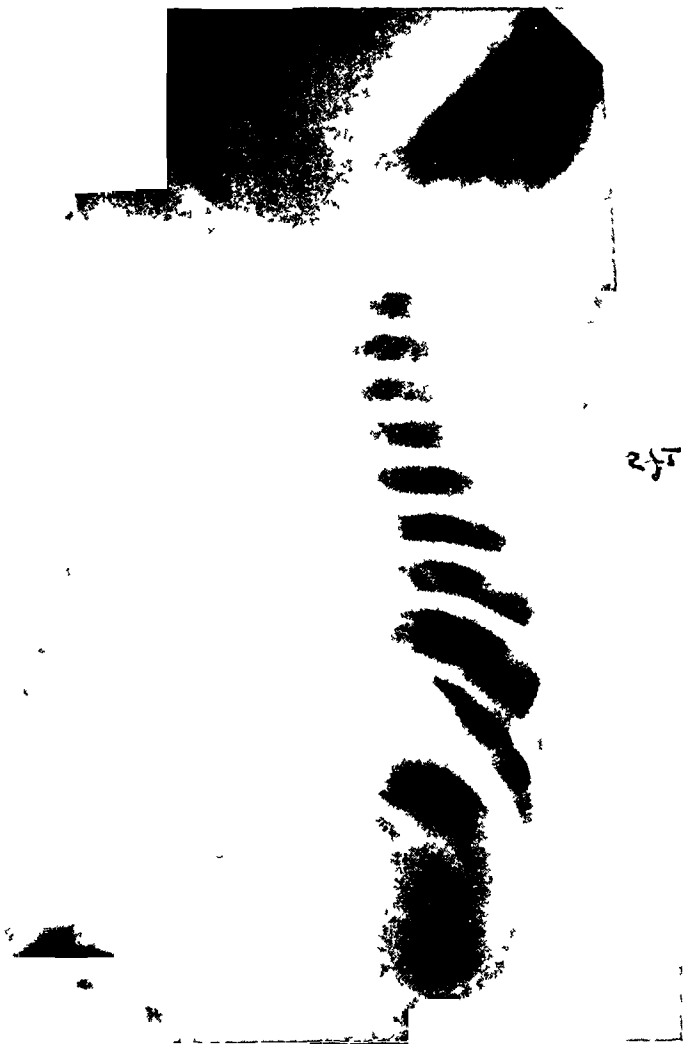


FIG. 16.—Case III. Displacement of heart and mediastinum to the right by valve type of obstruction to left primary bronchus. Expiratory bloc causes emphysema of left lung and absence of normal pulmonary markings.

Examination of the chest showed the right lung to be less resonant than the left, there being hyperresonance on the latter side. The heart and mediastinum were displaced to the right, otherwise the examination was negative. The temperature remained normal for six days except for a terminal rise to 102° on the day of death.

The X-ray showed the left lung to be less dense than normal and the diaphragm to be low and practically immobile with the heart and mediastinum greatly displaced to the right, indicating an obstruction to expiration on the left.

The dyspnoea and cyanosis became more pronounced, the child was desperately ill, and it was felt that a non-opaque foreign body might be a plausible explanation. On

bronchoscopic examination the left bronchus was found compressed to about one millimetre by pressure from without, the right bronchus was normal. There was no foreign body. The condition of the baby grew rapidly worse and respirations ceased a few hours later.

Autopsy revealed a cyst of the mediastinum with compression of the left primary bronchus. There was emphysema of the left lung and pneumonia. The heart and mediastinum were displaced to the right. There was a patent ductus arteriosus and foramen ovale. The left lung was enlarged and almost entirely covered the heart and encroached on the right pleural cavity to the costochondral junction

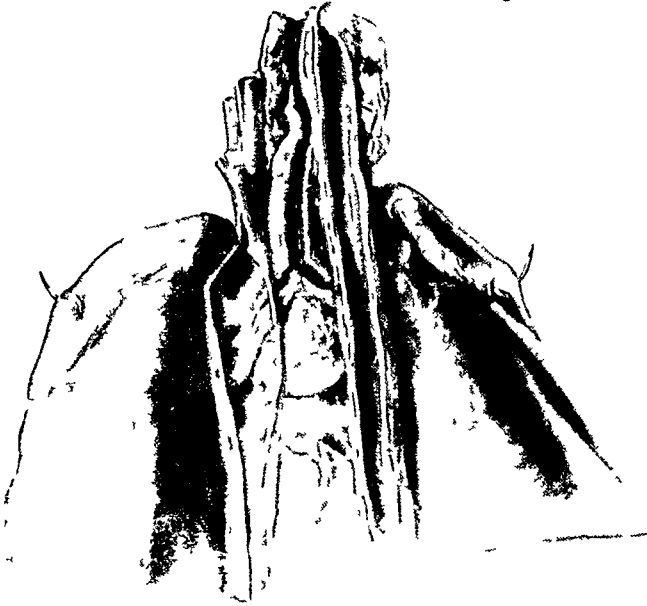


FIG. 17—Case III. Drawing of post mortem specimen. Posterior aspect. Cyst lies at bifurcation of trachea and causes compression of left primary bronchus.

of the ribs. The right lung was compressed somewhat by the mediastinum.

Pathological Report—In the mediastinum there is found a small cyst measuring about one and one-half centimetres in diameter. On the posterior surface of the cyst just under the bifurcation of the trachea, is a small mass about two millimetres in diameter, of the consistency of cartilage. This cyst appears to contain transparent fluid when held up to the light. Anterior to the cyst is the left auricle and left pulmonary artery. Superior to the cyst is the patent ductus arteriosus and the arch of the aorta. The cyst is located at the bifurcation of the trachea, and is placed slightly more to the left than to the right. Posterior to the cyst is the left bronchus, on which it appears to be causing pressure, and the descending part of the thoracic aorta. The vagus nerve theoretically is found medially to the cyst and almost posterior, but is not seen during dissection. The oesophagus is also found medially and posteriorly to the cyst. Lateral to the cyst is the right bronchus. The ascending arch of the aorta is anterior to the cyst. This cyst has caused the left bronchus to be compressed so that its lumen is distinctly smaller than usual.

Microscopically—This cyst is composed of fibrous tissue covered by an epithelium which in part is composed of pseudostratified, columnar, ciliated cells and a low cuboidal epithelium. This in addition covers a small mass of cartilaginous tissue. The major

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portion of the wall, however, is composed of fibrous tissue in which there is apparently but a very small amount of smooth muscle

COMMENT

The symptoms of cystic tumors of the mediastinum are chiefly caused by pressure. Paroxysmal cough of a brassy character, dyspnoea, and at times difficulty in deglutition or dysphagia are salient features. Pain has been frequently noted in the adult cases and hemoptysis may occur. The severity of



FIG 18—Case III Low power Field shows cyst lining of cubited epithelium, mucous glands smooth muscle and cartilage

the symptoms does not depend on the size of the tumor. In Case III of this series, a small tumor was the cause of death from direct pressure on the left primary bronchus. The course of the disease has been divided into a latent and an active period. An intrathoracic cyst may develop slowly and insidiously to great size, and the latent period may persist throughout life without occasioning symptoms, the tumor being accidentally found at autopsy. At other times the latent period is succeeded by an active stage in which an acceleration in the progress of the disease may be provoked by an intercurrent infection such as a pneumonia. Possibly chemical changes may occur in the contents of the cyst which stimulate an increase in the rate of growth similar to the rapid tumefaction that occurs in an inflamed wen. The transition from the latent to the active stage is illustrated by Case I in our series. In other instances the latent period is absent and symptoms are manifest at birth as occurred in Case II.

The physical signs are not characteristic and may suggest empyema or unresolved pneumonia. Bulging of the chest on the affected side may be

present and there is frequently lack of expansion. There is absence of tactile and vocal fremitus over the tumor and the breath sounds are distant or absent. The heart is frequently displaced, usually by direct pressure of the tumor or secondarily, as occurred in one of our cases, by emphysema and extreme distention of the lung due to an expiratory block. Emaciation or cachexia is not unusual.

In the roentgenological study of intrathoracic dermoids the visualization of a circumscribed tumor is not uncommon. In teratomata the identification of bone, teeth or calcareous deposits within the tumor is pathognomonic. In dealing with cysts of the gastrogenic or bronchogenic type, the X-ray is of less assistance. The evidence is variable. In the large tumors the film revealed a diffuse clouding of the affected side of the chest suggesting a pleural effusion. Where pressure on the bronchus from a small tumor produced an expiratory block, the findings were not incompatible with occlusion of the bronchus from a non-opaque foreign body. Radiographic study was of little help in the differential diagnosis. Its value lay in the definition of the size, shape and position of the cyst after aspiration of the fluid and injection of the opaque medium.

The character of the aspirated fluid assists in differentiating the dermoid from the entodermal cyst. If the material is oily yellow and contains cholesterol crystals or squamous cells, it is strongly indicative of a dermoid. The finding of hairs in the fluid or the sputum establishes the diagnosis. The secretion from the entodermal cysts was milky, mucoid and viscid. No characteristic cells were seen.

It is fascinating to speculate on the genesis of these tumors. Referring to dermoids irrespective of location, Ewing³ states that "a single origin through one-sided development of teratomata cannot be excluded for the entire group." The complex dermoids are probably imperfectly developed teratomata. He believes, however, that the importance of "budding" of originally simple embryonal tissues as a source of complex teratomata has probably been underestimated. Mediastinal and retroperitoneal dermoids may be of comparatively simple structure, but it is usually difficult to refer such growths to a local origin.

In the case of the gastrogenic and bronchogenic cysts under consideration it would seem that an explanation based on the embryological development would be adequate. In the four-millimetre embryo the "lungs and trachea appear as pear-shaped masses attached to the ventral border of the esophagus. The lower portion of the mass which bulges to each side represents the division of the trachea into bronchi. Its cavity is still in free communication with the esophagus. The trachea will become separated from the esophagus by downward growth of the lung buds and upward extension of the notch between the lung buds and the esophagus"⁴. The fusion of the lateral walls to form the tracheo-esophageal septum begins from below

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It would seem that at this embryonic stage, the pinching off of an outbud or diverticulum of foregut containing entoderm and mesoderm, and destined to become a portion of the stomach might well occur. This could be carried along by the downward growing lung bud and lodge in the mediastinum or on the surface of the lung. The cysts of bronchial origin might arise in a similar manner by the pinching off of a diverticulum of entoderm and mesoderm from the foregut in the region of the tracheal bud or by a secondary budding from the tracheal bud itself. The formation of these cysts takes place at a late stage of germinal differentiation while the dermoid is formed at an earlier period and the teratoma represents a primitive type of cell inclusion.

In a recently published report by Swanson⁵ and others an intrathoracic cyst in an infant is described that is of interest in this connection. The aspirated fluid was limpid, viscid and comparable to white of egg. It contained no fat or blood. The radiographic picture of the injected cyst in the right thoracic cavity is identical with that in Case I of this series. The cyst was drained and disinized and later formalin was injected. The histological examination of the specimen obtained at autopsy showed that the lining of the cyst was considerably disintegrated, as the result of treatment, but numerous mucous glands were identified. A submucosa, a circular and a longitudinal layer of smooth muscle and a large amount of fibrous tissue in which osteogenetic tissue was invading cartilage, were present. The presence of cartilage definitely proves it to be of bronchogenic origin, though in other respects, save for the disintegrated cyst lining, it resembles the gastrogenic cyst reported above in every particular as to its position, and gross and histological aspects. Two tumors so exactly similar though of different embryological origin could be best explained by arising through the same developmental error. The pinching off of a diverticulum at the time of the formation of the lung buds in the early embryo satisfies this requirement.

The duration is usually from one to five years following the onset of the active stage of the disease and it is obvious that surgery offers the only hope of cure in this group of intrathoracic tumors. Complete extirpation is necessarily accompanied by a high mortality and may only be accomplished after a number of stages. Many patients are in such poor condition before surgery is attempted that immediate removal of the tumor is contraindicated and drainage must be resorted to as a primary measure. This has the advantage that in large cystic tumors drainage permits the sac to shrink. On the other hand secondary infection produces a dense fibrosis, lines of cleavage are obliterated and the tumor can only be removed by sharp dissection with a greatly increased danger of injury to important structures. Beyer⁶ advocates an exploratory thoracotomy in preference to aspiration in cases of suspected dermoid. It would seem, however, that in doubtful cases aspiration was advisable to establish a diagnosis, and also to gain the information that injection of the cavity followed by X-ray will furnish, if the tumor should be cystic. Where the patient's condition permits, a complete extirpation at one sitting should be attempted in preference to preliminary drainage. In

the eight cases of dermoid cyst reported, that were treated by this procedure, there was only one death¹ Drainage or removal of the tumor was carried out in fifty-seven of the cases collected by Beye, with a mortality of 22 per cent Recovery took place in 37 per cent, improvement in 30 per cent and in 10 per cent the result was not stated Though the mortality is high, it should not be a deterrent to operation in a condition in which there is otherwise no means of palliation or cure

SUMMARY

Three entodermal cysts of the mediastinum are reported two of gastro-genic origin and one of bronchogenic origin

The symptoms and physical findings are similar to those encountered in intrathoracic dermoid and teratomatous growths in the same location

The fluid aspirated from these cysts is white, viscid and semitransparent

Histologically the two gastrogenic cysts present a typical section of the stomach wall There is a mucosa with glands containing chief and parietal cells, a submucosa, two layers of smooth muscle, one circular, the other longitudinal, and in one specimen a serosa and sympathetic nerve cells

The wall of the bronchogenic cyst is composed of fibrous tissue lined by epithelium in part ciliated Incorporated in the fibrous tissue is a small amount of cartilage and some smooth muscle

The genesis of these tumors may be from a pinching off of an out-bud from the foregut at the time of the development of the lung buds in the four-millimetre embryo

The treatment of cysts of the mediastinum is preferably extirpation in one stage Preliminary drainage may be indicated Though the mortality is necessarily high, it should not be a deterrent in these otherwise hopeless cases

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- ³ Ewing Neoplastic Diseases, third ed, p 1016, 1928
- ⁴ Keibel and Mall Embryology, vol II, p 312, 1912
- ⁵ Swanson, Platon and Sadler Am Jour Dis Children, vol XXV, p 1024, 1928
- ⁶ Beye ANNALS OF SURGERY, vol LXXVIII, p 577, 1926

DISCUSSION DR CARL A. HEDBLUM of Chicago, Ill., remarked upon the importance of the differential diagnosis between such tumors and carcinoma of the lung than that of other organs The special practical importance of the differentiation lies in the operability of the benign growths

Dermoids of the mediastinum may simulate a variety of other conditions He had personally observed four cases In two cases the findings were those of chronic empyæma, in one that of a large encapsulated effusion and in one that of a pulmonary abscess The fourth was repeatedly drained as

for abscess. Later, wide open thoracotomy was performed to determine the reason for the persistent drainage. Stratified epithelium was found in the wall of the abscess and hair in the cavity.

DR CHARLES G MIXTER (closing the discussion) said, in regard to mortality and the statistics as previously published, that in the cases reported last year by Kerr eight instances of primary extirpation of tumor were reported with one death. Some years before fifty-eight operated cases had been reported with a recovery of 37 per cent, another 30 per cent of cases improved. In other words, these cases should offer a fairly hopeful field for radical surgery.

PARATHYROIDECTOMY IN OSTEOMALACIA

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FROM THE MEDICAL AND SURGICAL SERVICES OF THE MASSACHUSETTS GENERAL HOSPITAL

THE extent to which disturbance of endocrine function may underlie generalized diseases of the skeleton has long been a matter of interest. With the clearer appreciation of the physiology and clinical importance of the parathyroid glands, made possible through the availability of a potent parathyroid extract as a result of the work of Collip¹ and others, this relationship takes on a new importance.

The osseous framework of the bones is clearly not a static structure, but one with an active metabolism readily changing even in adult life according to disuse or activity, or in response to demands made upon it through variations in the inorganic salt metabolism of the body. Clinically the relationship of osteomalacia to repeated pregnancies and lactation or to an abnormal diet is well known. That bone atrophy may occur in response to the increased calcium and phosphorus metabolisms in thyrotoxicosis has been demonstrated.^{2, 3} Decalcification of bones may be brought about by the long continued administration of Collip's parathyroid extract.^{4, 5} The cancellous bone serves as the most readily available supply of body calcium in response to the metabolic demands made by this hormone. The shafts have a slow progressive exchange of inorganic salts, and are not influenced except in the case of unusual body demands.⁵

The association of pathological changes in the parathyroids with generalized diseases of the skeleton is well known. It may be sufficient here to present the findings of Hoffheinz⁶ who was able to collect from the literature forty-four cases of enlargement of the parathyroid glands found at autopsy, usually of the nature of hyperplasia. He also presented in detail one case of his own. Among these cases, skeletal disease was described twenty-seven times. Osteitis fibrosa occurred seventeen times, osteomalacia eight, and rachitis twice. The theory which had been commonly accepted to account for this relationship explains the enlargement on the basis of a compensatory hypertrophy as a consequence of the unusual demands made upon the parathyroid apparatus through the excessive calcium metabolism brought about by the skeletal disease. Hoffheinz⁶ points out that certain facts are in disagreement with this theory. In a great number of cases both

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of osteitis fibrosa and of osteomalacia, pathological changes in the parathyroids are not found although the demands of excessive calcium metabolism are present. Again when parathyroid enlargements do occur, in 85 per cent of the cases only one gland of those present is affected a finding difficult to explain on the basis of compensatory hypertrophy. On the other hand, it is more likely that the enlargement of the parathyroids is the cause and not the consequence of an abnormal calcium metabolism, and hence of the skeletal disease (Simmonds,⁷ Mandl,¹³ Gold,¹⁶ Bair¹⁷)



FIG 1—Skull X ray of head, showing malocclusion of teeth, changes in the calvarium, and enlarged sinuses



FIG 2—Thorax X ray of thorax, showing abnormal curvature of ribs

We are greatly indebted to Dr E F Du Bois, who referred the following patient to the Massachusetts General Hospital for continuation of metabolic studies undertaken at the Russell Sage Institute of Pathology at the Bellevue Hospital, New York. Doctor Du Bois's observations showed so great a variation from the normal in calcium and phosphorus metabolism that he suggested that the patient represented an instance of hyperparathyroidism. The clinical history and metabolic studies of this case will be presented in detail elsewhere.^{8,9}

The important points follow. The patient, a master mariner, thirty-four years of age, was admitted to the hospital April 24, 1926. Up to 1918 he was an athletic man in perfect health, six feet one inch tall and weighing 185 pounds. He ate a well-balanced diet, except for a short time in 1918, when there was a deficiency of calcium in his diet. His trouble began about June, 1919, and was characterized by pains in the knees, hips and sacral region. About six months later he became noticeably pigeonbreasted. His height progressively diminished to five feet six inches. Muscular weakness and clumsiness gradually developed. He was forced to give up work, and eventually became almost completely incapacitated. At times he had urinary frequency, occasionally with the passage of white gravel. During these years he had seven fractures, caused usually by slight injury.



FIG 3—Hip. Upper right femur showing largest bone cyst, and disappearance of cancellous and cortical bone.

Examination showed an alert, intelligent man in good color and state of nutrition, apparently organically sound, aside from the changes in the skeleton. The chief of these were a general forward bowing of the spine, with obliteration of the lumbar curve, a barrel-shaped chest, the lower ribs almost impinging on the iliac crests,

shortening of the neck, and malocclusion of the teeth. The extremities showed no obvious deformity aside from bowing of the left forearm from the previous fractures.

On roentgenological examination, practically all the bones showed a diminution of bone salts and rather coarse trabeculae. All the vertebrae showed atrophy, the lumbar vertebrae particularly, these appeared compressed. The pelvis was narrower than usual. Proliferative changes were found about each sacroiliac joint. There was considerable atrophy of the femora with thinned cortex and slight lateral bowing. In the upper part of the right femur there was a cyst-like area about three centimetres in the greatest diameter. Two similar areas, about one centimetre in diameter, were found in the left femur. The bones

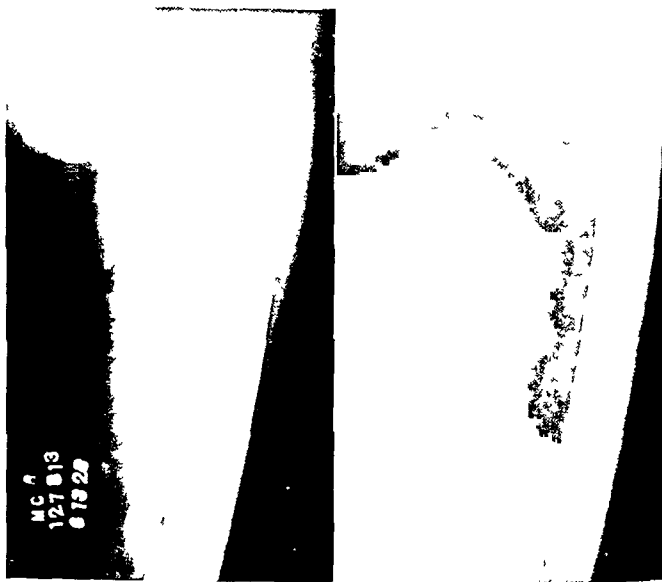


FIG 4—Left femoral shaft. X-ray of femoral shaft showing increase in cortical bone two years after operation. (Left)

of the arms showed similar atrophy with a few cyst-like areas in the humeri. Bony union had occurred at the sites of the fractures. Atrophy had led to retraction and abnormal curvature of the ribs. The calvarium was thickened and mottled in the frontal region, and thinner than normal posteriorly. The sinuses were enlarged, the sella turcica normal in size and contour. (See Figs. 1, 2 and 3.)

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The diffuse character of the changes in the bones on Rontgen-ray examination would suggest the inclusion of this case under the general heading of osteomalacia although cystic cavities similar to those described as osteitis fibrosa were present

The evidence in favor of hyperparathyroidism in this case may be brought out by contrasting the effect of parathyroid extract with the changes occurring in parathyroid tetany. If a potent parathyroid extract

is administered there results a rise in the serum calcium, a rise in the urinary calcium excretion, a fall in the serum phosphorus, and a rise in the urinary phosphorus excretion^{10 11}. If the administration of such an extract be continued for a sufficient period of time there results decalcification of the bones

easily demonstrated by X-rays. With deficiency of the parathyroid glands the converse results, a fall in the serum calcium, a fall in the urinary calcium excretion, and a rise in the serum phosphorus, and a fall in the urinary phosphorus excretion¹².

Calcium and phosphorus metabolism studies in this case revealed the following⁹:

1 A markedly elevated serum calcium (13.1 to 15.3 milligrams per 100 cubic centimetres as compared to a normal serum calcium of 9.5 to 10.5 milligrams per 100 cubic centimetres)

2 A markedly increased calcium excretion due entirely to an increased urinary calcium elimination. The urinary calcium excretion was six to seven times greater than was found in fifteen normal individuals studied under identical conditions



FIG 5—Lower leg and foot. X ray of lower leg and foot showing increase in cortex and in definiteness of trabeculae. Plates taken April 4, 1926 and June 13, 1928 (Right)

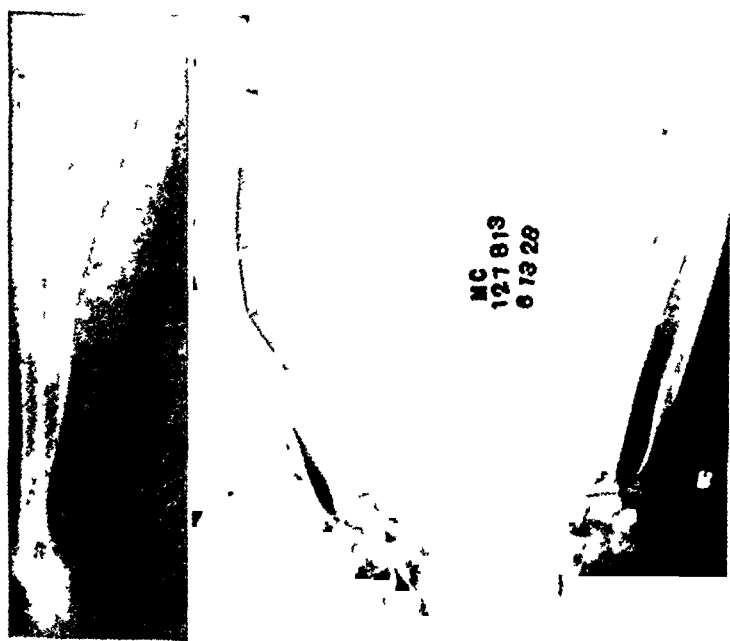


FIG 6—Arms. X ray of arms, April 28, 1926, and June 13, 1928 (Right)



FIG 7—Right parathyroid, low power

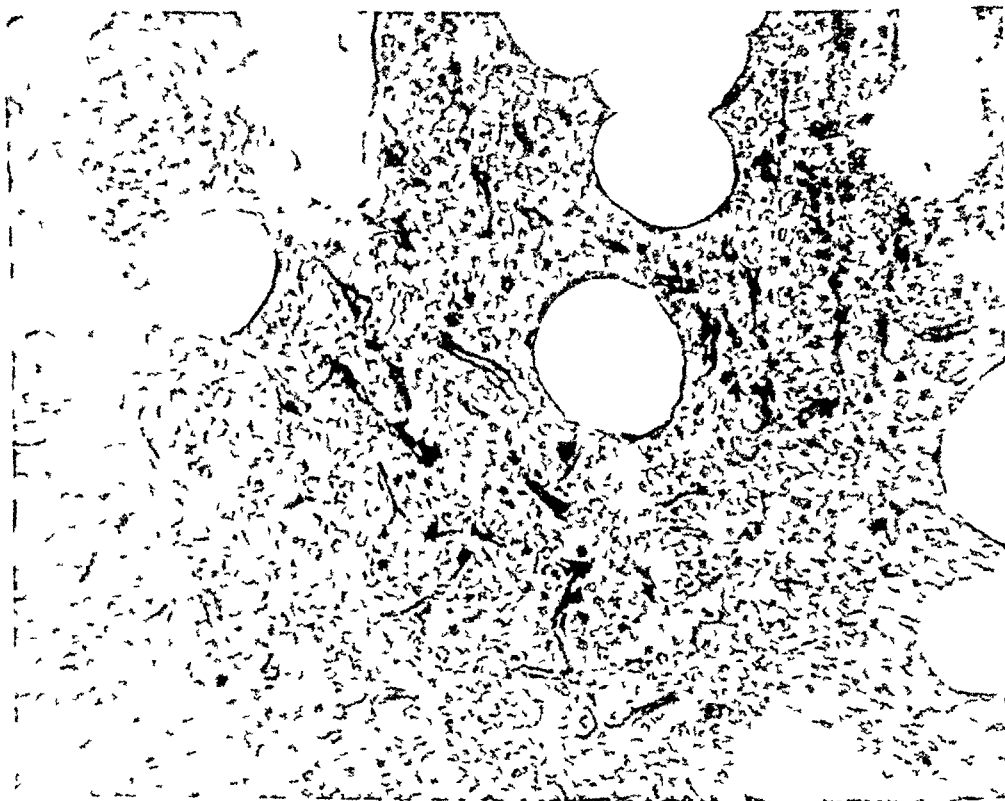


FIG 8—Right parathyroid, high power

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3 A considerably reduced serum phosphorus (1.4 to 3.2 milligrams per 100 cubic centimetres as compared to a normal serum phosphorus of 3.5 to 4.5 milligrams per 100 cubic centimetres)

4 An increased phosphorus excretion

The changes in the calcium and phosphorus metabolism observed in this case were approximately the equivalent of those found in a normal individual while receiving 100 units of Collip's parathyroid extract a day

On account of these abnormal metabolic findings it seemed reasonable to conclude that this patient was suffering from an increased function of the



FIG. 9—Left parathyroid, low power

parathyroids, or hyperparathyroidism, and that his osteomalacia was secondary to the abnormal loss of calcium so produced. For this reason operation was offered, and was readily accepted. Because of the pathological association of bone disease with parathyroid change previously mentioned, it was supposed that an adenomatous enlargement of a parathyroid gland might be present, although the thyroid was barely palpable and no tumor in the neck could be felt. If such were the finding, it would be excised, if no tumor were found, one parathyroid would be removed. At the time we had no knowledge of an operation on the parathyroids having been undertaken with a view to reducing calcium loss from the bones, although Mandl's preliminary report had appeared.¹³

Operation was undertaken May 17, 1926, under ethylene anaesthesia. We were apprehensive that struggling during induction of an anaesthetic might lead to further fractures. The right lobe of the thyroid was exposed, freed and turned inward. Close to the inferior

artery, in the expected position, a structure resembling a normal inferior parathyroid gland was found and removed. On microscopic examination, however, it later proved to be normal thyroid tissue. An encapsulated lobule of yellow fat, receiving its blood supply through a twig from the inferior thyroid artery, was displaced together with the thyroid lobe, and seemed intimately connected with the thyroid capsule. This fat proved on section after removal to enclose a normal parathyroid gland (See Figs 7 and 8). The superior parathyroid was not seen.

Following the operation no appreciable change in metabolism resulted. Accordingly exploration of the other lobe of the thyroid was suggested, with a view to removing another parathyroid, and was undertaken June 11, 1926. On exposure of the posterior surface of this lobe, no structure resembling a parathyroid gland was found. However, in view of the experience on the other side, five yellow lobules of fat were removed, one of these, situated close to the inferior thyroid artery, proved to enclose, on microscopic examination, a parathyroid gland normal in structure aside from fatty infiltration, similar to the one previously removed (See Fig 9).

Microscopic examination of these two parathyroids, by Dr Tracy B. Mallory, showed (1) May 17, 1926. A longitudinal section of a parathyroid gland. It is not enlarged. The stroma contains numerous large fat cells. The glandular substance itself is not atypical. The epithelial cells show a distinct alveolar arrangement and occasionally surround droplets or larger masses of colloid-like material. The majority are of the "clear" vacuolated type. Usually from one to two of the "oxyphile" cells are present in each alveolus. These show a larger amount of cytoplasm than the "clear" cells. They are unvacuolated and are filled with one eosinophilic granule. The proportion of these cells to the "clear" ones is about one to eight. No mitotic figures are found.

Diagnosis—Normal parathyroid gland.

(2) June 12, 1926. A section of a parathyroid gland. It is not abnormal in any way and the proportions of "clear" and "oxyphile" cells are essentially the same as in the specimen removed one month previously. The absence of histologic evidence of hyperplasia in no way rules out the possibility of physiologic overactivity (Aschoff).

Diagnosis—Normal parathyroid gland.

At the time, we felt that even if a parathyroid deficiency resulted, we had in Collip's parathyroid extract a means of combating it indefinitely, comparable to the use of insulin in diabetes. However, it has since become apparent that parathyroid extract, as at present supplied, may lose its effectiveness¹¹. Recognizing the seriousness of chronic tetany, and the great difficulty in alleviating its effects, in another case we should hesitate to run the risk of serious damage to the parathyroid apparatus through so extensive a dissection.

Following this second operation there was still no appreciable difference in the calcium and phosphorus metabolism. However, the patient had shown greater ability to retain calcium on a diet high in calcium, and evidence of this calcium retention was present in the bones on Röntgen-ray previous to discharge October 9, 1926.

Since this time the patient has done well, and has progressively improved, so that on June 11, 1928, when last seen, he stated that he felt very well, was able to get about without difficulty, and had been working for ten months. Röntgen-rays taken for comparison with previous plates showed a marked increase in the amount of calcium deposit in his bones* (See Figs 5, 6 and 7).

We have very little evidence that removal of two parathyroid glands contributed in any way to this result. We should like to stress the importance

* A letter dated May 4, 1929, from the patient states that he has been working in an office since October 15, 1927. He walks a mile and a half a day in the course of his duties, and feels well aside from easy fatigability and soreness of muscles after unusual exertion. He has had no further fractures, although he incurred two bad falls during last winter.

of a diet high in calcium and in phosphorus, particularly the latter, under conditions where it is apparent that there is a drain of calcium from the body.⁹ While remissions occur during osteomalacia, and spontaneous cures may rarely take place, a result such as in this case is very unusual.

The experience of others in removing parathyroid tissue supports the idea that increased function of the parathyroids may underlie changes in the skeleton with loss of calcium from the bones.

The first case in which operation was undertaken is that of Mandl¹¹ who reports a case of generalized osteitis fibrosa in a man, thirty-eight years of age, for which parathyroidectomy was performed. This patient had an increasing disability with pain in the bones during five years, eventually causing him to be bedridden. The transplantation of four human parathyroids resulted in no benefit. Four weeks later, July 30, 1925, the thyroid region was explored and a tumor of the left lower parathyroid, twenty-five by fifteen by twelve millimetres in size, was removed. The other parathyroids appeared normal. The daily urinary calcium excretion before operation was 54 milligrams, on the eleventh day after operation, on a similar diet, it was 76 milligrams. Four months after operation the patient was subjectively improved. His pain had diminished, he had gained weight and was able to walk with a crutch and cane. Two and a half years after operation,¹ he had gained sixteen kilograms in weight, and was able to walk with a cane. Complete recovery had not occurred.

Mandl¹¹ operated on a second case of generalized osteitis fibrosa in a man, forty-four years of age, with a three years' history of increasing disability which eventually confined him to bed. However, the urinary calcium excretion of this patient was within normal limits. His blood calcium was 12.5 milligrams. No parathyroid enlargement was found at operation, but one parathyroid which showed fatty degeneration only was removed. The patient showed slight subjective improvement six weeks after operation, but this could not be confirmed objectively. Mandl suggests that the presence or absence of an abnormal calcium metabolism will give us information as to the presence or absence of a parathyroid tumor.

Gold¹⁰ reports the case of a woman, fifty-four years of age, who gave a history of progressive disability during three and one-half years, accompanied by pain. Rontgen-ray examination showed the changes of generalized osteitis fibrosa. No tumor could be felt in the neck. At operation, July 20, 1927, a small thyroid was exposed. On turning the right lobe inward, a tumor-like enlargement of the upper parathyroid, in size twenty-five by sixteen millimetres, was exposed and removed, this was microscopically a benign adenoma. Following operation the blood calcium fell from 13.1 milligrams to normal, the daily urinary excretion of calcium, previously twice normal, fell to about one-third of the normal value. The patient was subjectively greatly improved following operation, the pain was much relieved, she could attend to her housework and she had gained eleven kilograms in weight when last heard from, six months after operation. However, an improvement in the diseased bones could not be established roentgenologically.

Barr and others¹² have reported an instance of hyperparathyroidism occurring in a woman, fifty-six years of age. This patient, who habitually used an unbalanced diet, developed urinary symptoms and an increasing difficulty in walking which led to total disability. Examination showed a remarkable degree of muscular hypotonia, bilateral nephrolithiasis, changes in the bones—tumors of a finger, of the ulna, and of the maxilla, and sufficient rarefaction of the bones to justify the diagnosis of osteomalacia. The tumors of the finger and of the ulna showed the microscopic appearance of giant-cell sarcoma. The blood calcium was 16 milligrams and the metabolic studies showed a constant negative calcium balance, with a loss of calcium which became greater with any increase of calcium in the diet.

A nodule the size of a small walnut could be felt in the left lobe of the thyroid. This

was removed, and proved to be a parathyroid adenoma. The patient developed tetany two days later, from which she partially recovered under treatment. The blood calcium became lower than normal, she retained large amounts of calcium, the tumor on the jaw became smaller, and the teeth which had been loosened over the area of the tumor became tightened.

From these experiences it would seem clear that given generalized disease of bone, with loss of calcium not otherwise explainable, whether of the type of osteomalacia, osteitis fibrosa, or of some similar condition, particularly if accompanied by muscular weakness, overactivity of the parathyroids should be suspected. Here an estimation of the blood calcium and the loss of calcium in the urine is particularly desirable. If these chemical findings are similar to those produced by parathyroid extract, such as an increase in the blood calcium and excessive loss of calcium in the urine, this suspicion is given additional weight. This loss of calcium should be combated, as in the case of bone changes from an unbalanced diet or repeated pregnancies, by a diet high in calcium and phosphorus. If the patient is unable to store calcium under this regime, operation for removal of the parathyroid tissue should be considered. This indication is clearer if a nodule suggestive of a parathyroid tumor is palpable. However, in neither of Mandl's nor Gold's cases, where such a tumor existed, was it felt before operation.

The case here reported, as an example of hyperparathyroidism, is incomplete in two respects. In the first place, the two parathyroids removed showed no microscopic evidence of overactivity. In the second place, their removal exerted little effect on the inorganic salt metabolism. It is of course possible that a tumor of an aberrant parathyroid was overlooked. However, the metabolic findings were consistent with overactivity of the parathyroid glands, and the development of bone atrophy is adequately explained on this basis.

CONCLUSIONS

- 1 Generalized skeletal disease with disappearance of salts from the bones may be explained in certain instances on the basis of overactivity of the parathyroid glands.

- 2 In order to justify a diagnosis of hyperparathyroidism in an individual, there must exist marked decalcification of the bones, muscular hypotonia, an elevated serum calcium, an increased calcium excretion, a reduced serum phosphorus and an elevated phosphorus excretion.

- 3 When excessive calcium loss from the body is not explainable on any other ground, and cannot be combated in any other way, exploration of the parathyroid glands, with a view to removing parathyroid tissue, is justifiable.

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DISCUSSION DR CHARLES L GIBSON of New York City described a case admitted to the New York Hospital in the service of Dr Lewis A Conner and worked up by Doctor Foster The case is described as one of hypercalcemia The history is as follows

A woman, fifty-seven years of age, was admitted to the New York Hospital complaining of pain in the anterior portion of the chest and in the sacro-iliac region, of three months' duration The past history was essentially negative and there were no other symptoms except a loss of twenty pounds in weight during the three months previous to admission She was a fairly well-developed and well-nourished woman with evidence of a secondary anæmia No other positive findings were elicited except for a thickening of the interphalangeal joints and a limitation of motion of the spine, due to bony changes *X-ray examination* showed an extensive hypertrophic osteo-arthritis involving the spine, with a partial decalcification of the dorsal and lumbar vertebrae and the iliac bones *Laboratory findings* Nothing abnormal except a mild secondary anæmia Examination of blood showed

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the calcium to be elevated to 15.3 mgm per 100 c.c. on admission. Five days later the blood calcium was 17.1 mgm per 100 c.c.

During the two weeks after admission extensive studies were made on the patient and no other pathology was found. The patient began to have attacks of vomiting which increased in severity and in frequency until at a time two weeks after admission she was unable to take even fluids by mouth. Blood calcium determination at this time was 18.7 mgm per 100 c.c. The severe vomiting continued and it became necessary to combat the dehydration with numerous hypodermoclyses and infusions. Blood calcium during the third week after admission reached 19.4 mgm per 100 c.c. and 18.2 and 18.6 mgm per 100 c.c. during the fourth week. Vomiting and dehydration increased and the patient became weaker, although the temperature remained about normal throughout the illness. Transfusion was done with no avail.

Seven weeks after admission the blood calcium was found to be 15 mgm per 100 c.c. and at this time parathyroidectomy was advised. At operation three parathyroids were removed under ethylene anaesthesia.

Immediately following the operation there was little or no reaction. The patient became progressively weaker, however, and died eighteen hours post-operative. There were no signs of tetany at any time. Pathological examination of the excised parathyroid glands showed the glands to have undergone evident regressive changes. Post-mortem examination was refused.

NOTE. No parahormone treatment given.

DR FRANK H. LAHEY of Boston, Mass., said that sometime ago, he suggested that all parathyroid glands found on removed thyroid specimens be immediately transplanted, and published a description of a method and his experiences with it. He had now transplanted over three hundred bodies which at least had the possible appearance of parathyroids. Before transplanting these suspected bodies, a section has been taken from each one and sent to the pathologist, and of these transplants, but one hundred have been proven microscopically to be parathyroids.

Doctors R. B. Cattell and R. L. Mason, working in the Clinic, have done thyroparathyroidectomy upon dogs with immediate grafting of one parathyroid gland into the sternomastoid.

Sometime ago, Doctor Halstead demonstrated the feasibility of reimplantation of removed parathyroids, and in this experiment Doctors Cattell and Mason have gone a little further. They first demonstrated that the animal had a normal blood calcium, then removed all of the parathyroids, reimplanting one in the muscle, and produced clinical tetany and a drop in blood calcium. The animal was then carried on parahormone for two weeks while the graft was taking, and at the end of this time (two weeks), parahormone was discontinued without a return of tetany and without a drop in blood calcium. The dog was allowed to live for three months during which time there was no tetany and at the end of this time, the graft was excised from the sternomastoid with the immediate appearance of tetany, a drop in blood calcium, and the demonstration of the living parathyroid graft in the muscle. Doctor Halstead has demonstrated that these parathyroid grafts will not take unless all of the parathyroids have been removed and a parathyroid deficiency is present.

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In view of the above, he believed in the cases described by Doctor Richardson, which must necessarily be rare, if removal of two and certainly three of the parathyroids be done, it would be a wise provision to transplant one of them into the sternomastoid. If, then, all of the parathyroids have been removed, the deficiency will permit the grafted parathyroid to take and thus prevent tetany, and if no deficiency be present, the graft will not take and a subtotal parathyroidectomy will have been accomplished safely.

DR GEORGE W CRILE of Cleveland, Ohio, said that surgeons had had more trouble than they should have in getting successful transplants of the parathyroids. The transplants haven't always grown. Lately, he had taken the precaution to cut out a small amount of the thyroid itself right around the parathyroid so that the new implantation is associated with its old friend, the thyroid. Those transplants in which this has been done apparently have done well.

PAROXYSMAL HYPERTENSION ASSOCIATED WITH TUMOR OF THE SUPRARENAL

BY ARTHUR M SHIPLEY, M D
OF BALTIMORE, MD

THIS report has to do with *paroxysmal hypertension* associated with *tumors of the medulla of the suprarenal body*. The patient whose case is reported was referred to me by Dr Maurice C Pincoffs, who reported the point of view of diagnosis and clinical aspects before the Association of American Physicians on May 8. Portions of the tumor after removal were used for experimental work by Dr William H Shultz, and the three of us will publish a full report of all phases of the case later.

We are not concerned in this report with tumors of the suprarenal cortex. The medulla of the suprarenals is a part of the chromaffin system which is not confined to the suprarenal body. The two portions of the suprarenal, cortex and medulla develop from entirely different tissues, the cortex develops from the mesoderm. "The immediate anlage of the suprarenal medulla and the anlages of the remainder of the chromaffin organs lie in the sympathetic ganglions, which, in turn, are derived from the cells of the neural crest." These primitive cells of the ganglions are called sympathogonia or the sympathetic formative cells. In early foetal life these cells migrate laterally toward the suprarenals. "During the migration, portions of the embryonic tissue may become split off, these develop as separate organs at varying distances from the aorta in the region of the renal arteries or the inferior mesenteric artery to form the organs of Zuckerkandl."

The first report of a tumor of the medulla of the suprarenal body was by Berdez,¹ in 1892. That these tumors may be associated with hypertension was pointed out by Neusser,² in 1898, who reported two tumors of the adrenals described by him as carcinoma. Vaquez,³ in 1904, associated hypertension with increase of epinephrin in the blood. No one has proven, up to the present, that an increase of epinephrin is found in the blood in patients with hypertension. Many clinical observations in patients with chromaffin cell tumors of the suprarenal glands indicate that this is true, but the proof is not forthcoming.

Oppenheimer and Fishberg⁴ give three varieties of tumors derived from the medulla of the suprarenal:

- 1 Sympathoblastomas, made up of immature sympathoblasts
- 2 Ganglioneuromas, consisting of relatively mature sympathetic ganglion cells
- 3 Paragangliomas, which is the type of tumor with which we are concerned in this paper. These are rare tumors and Rabin⁵ was able to find only thirty cases in the literature, and in an excellent article in the *Archives of Pathology* for February, 1929, he discusses these cases and reports one of his own.

These tumors of the medulla of the suprarenal body have been given different names—perithelioma, paraganglioma, chromaffin cell tumors and pheochromocytoma. They were formerly considered as types of sarcoma, but it is now known that the majority of them are benign and encapsulated. Of the thirty tumors of medulla of the suprarenals many had associated with them hypertension, instability of the vasomotor system or glycosuria. Only three of them, however, showed paroxysmal hypertension. We mean by this that at irregular intervals the blood pressure will rise sharply 100 or more points above the normal and these rises will be accompanied by heart consciousness, rapid pulse flushing, nausea or headache and that after a few hours' interval the pressure will return to normal.

We have been able to find in the literature only three cases of paroxysmal hypertension associated with chromaffin tumor of the suprarenal. The first case reported was by Labbe, Tinel and Doumer.⁸ This patient had attacks of paroxysmal hypertension associated with œdema of the lungs and in one of these attacks she died. Autopsy disclosed a tumor of the medulla of the left suprarenal.

The second case was reported by Oberling and Jung.⁷ This patient was a woman, twenty-eight years of age, with a normal pregnancy and delivery in 1922. In 1927, close to term in a second pregnancy, she was found by her physician to have a pressure of 250/190, with well-marked albuminuria and severe headaches. The following day in hospital her pressure had fallen to 180/150, and in the ensuing few days the pressure was quite variable between about 170/110, and 220/155. She delivered normally, but went into a state of shock two hours after delivery with a pressure of 130/120, and a pulse of 150. She died in this condition a few hours later. At autopsy a kidney-sized, encapsulated tumor was found replacing the left adrenal. The histological structure identified it as a paraganglioma.

The third case was reported by Dr. Charles H. Mayo.⁶ This patient was having attacks of paroxysmal hypertension and exploratory laparotomy was done, because it was thought that some pathology of the splanchnic nerves might be responsible for the attacks and because there was abdominal pain. A tumor was found that was retroperitoneal, behind the tail of the pancreas and impinging upon the upper pole of the left kidney. Doctor Mayo reported in addition to the tumor which was removed that the left suprarenal body was twice its normal size and that the right one was apparently slightly enlarged. The patient recovered and the symptoms disappeared. The microscopic diagnosis was retroperitoneal malignant blastoma.

Another case was reported which was not confirmed by either operation or autopsy, but it seems probable that the clinical diagnosis of paraganglioma was correct. Vaquez and Donzelot⁹ reported this case in 1926. A young man, thirty-seven years of age, who showed very striking attacks of paroxysmal hypertension. The authors, on purely clinical grounds, were led to the belief that this was a case of suprarenal paraganglioma, similar to the one reported by L'abbe, Tinel and Doumer. The patient left their service, however, and later came into the care of Laubry,¹⁰ who reported the outcome in a separate article in 1927. Laubry, accepting the clinical diagnosis of Vaquez, subjected the patient to deep X-ray treatment over the adrenals with the result that the attacks diminished and finally disappeared entirely and had been absent for six months at the time of his report.

CASE REPORT—The subject of this report came to see Doctor Pincoffs because of "attacks with palpitation of the heart." She was twenty-six years old, had been married one year, with no pregnancies. She had always been very active with a sanguine temperament. At this time a sister had a mass in the upper chest, which interfered with breathing and caused distention of the neck vessels.

Ten years before, when she was at school, she suffered at about weekly intervals with attacks of flushing and warmth in the right arm, associated with a sudden feeling of being shaky and nervous. She thought these attacks were brought on by playing basketball. They were brief in duration and after a few months they disappeared. After three or four years the attacks returned, but somewhat different in nature. They would begin with a hot, flushed feeling in both arms followed by a sensation of tightness and compression over the heart, which would beat forcibly. There was a feeling of difficulty in breathing and of swelling of the neck. After some time, nausea would appear and if she forced herself to vomit, some relief of symptoms would be obtained. The vomitus contained whatever might be in the stomach.

At first the attacks were infrequent, but gradually the interval between them shortened. They occurred at any time, but rarely late at night. She could not make out that any particular act of hers precipitated the attacks. They had a tendency to recur at about the same hour each day. She usually had at least one attack daily and sometimes, when the paroxysm was a light one, there would be a severe attack in the evening.

When she came in the hospital for study, the attacks were increasing in violence and frequency and severe occipital headache was an increasingly troublesome symptom. She had been in the habit of going off to herself and sitting quietly through the attacks. Afterward she felt entirely well. During the attacks there would be some apprehension, because of the symptoms, especially the sense of constriction and difficulty in breathing, the forceful heart action and a shaky, nervous feeling.

In addition to these symptoms there were frequent attacks of diarrhoea and vomiting, without fever. Her habits were negative, except for excessive cigarette smoking. During the preceding year she had had swelling in both parotid regions a number of times, which came on suddenly, was painless and without fever. This swelling would persist several weeks. In the first attack it was diagnosed mumps.

The physical examination was negative. The chest was clear. The heart was normal in position and size, sounds clear, good rhythm, pulse rate normal, blood pressure 120/90. Abdomen negative. Blood count normal. Wassermann negative. Stool normal. Two specimens of urine were examined, both showed a trace of albumen and one a definite reduction for sugar, confirmed by fermentation.

The patient was next observed in an attack. It was found that as soon as symptoms were complained of the blood pressure was already 190/98. It rose gradually to 219/110, and in the next half hour fell to 176/76. During the height of the attack there was marked pulsation of the vessels of the neck, the jugulars were prominent, the hands, feet, knees and nose were quite cool to the touch, the face a little flushed, there was marked tremor of the hands, the respirations were shallow and increased to 36, and the pulse rose gradually to 110, and fell to 76, with the fall in pressure.

A number of similar attacks were observed. It was proved that between the attacks the pressure was always normal. In one paroxysm the systolic pressure rose above 260, beyond where the instrument used could register it. Irregularities developed in the pulse toward the end of the attack. These were studied with the electrocardiograph and showed short runs of both auricular and ventricular tachycardia.

She remained in the hospital eight days under observation and in addition to the examinations described above, a number of fruitless studies were made which added nothing to our knowledge of the nature of the attacks.

Because of the foregoing history and examinations, a diagnosis of tumor of the suprarenal was made by Doctor Pincoffs. The thing that immediately concerned us was to determine which gland was involved. We had found two patients with similar symptoms in the literature and in both, the tumor was on the left side. The most careful palpation and percussion gave us no help and X-ray examination showed nothing unusual on either side. It would be difficult to remove either suprarenal through one incision unless a mid-line incision were used and a transverse cut through the rectus muscle and lateral abdominal wall were made toward the side of the tumor. We were

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afraid of a prolonged operation, because of the great hypertension during attacks and the rapid fall in blood pressure at the end of the attacks. We decided to guess as to the side of the tumor and if we guessed wrong to close that incision and to operate later through another approach.

Accordingly, June 14, 1928, a high left rectus incision was made and the left kidney and post-peritoneal region carefully explored. The left suprarenal was normal in size, consistency and shape and no evidence of any post-peritoneal tumor on the left side was found. There was a little accessory spleen in the peritoneal folds just lateral to the spleen. This was definitely splenic tissue and was about the size of a marble. The right side of the abdomen was then explored by palpation and a large, somewhat kidney-shaped tumor mass was felt just above the right kidney, between it and the liver, on a plane a little anterior to the kidney and mesial to it. It had some range of motion, was behind the peritoneum and was not attached firmly to either kidney or liver. It had about the consistency and movability of an enlarged thyroid in Graves's disease. It could not be reached through the left rectus incision and so it was decided to close the abdomen and wait until healing had taken place and then to approach the tumor through a different incision. The patient made a good operative recovery, although she continued to have almost daily attacks of paroxysmal hypertension. In one of these attacks she developed considerable dyspnea, cyanosis and a very high blood pressure and it seemed, for a time, that she had developed a pulmonary infarct. These symptoms rapidly cleared up, however, no physical signs in the chest persisted and there was no spitting of blood.

Thirteen days later on, the patient was operated on the second time. She was placed on the operating table

with her body tilted, so that the anterior axillary line on the right side was uppermost. A short incision was made parallel to the costal margin, extending from the outer border of the sheath of the right rectus muscle to the end of the eleventh rib (Fig. 1). The peritoneum was opened through this incision and the tumor palpated. It was found that it could be reached best by lengthening the incision intercostally between the tenth and eleventh ribs. This was done. This exposed the lower margin of the right lobe of the liver. Some difficulty was had in retracting the edges of the wound. Accordingly, both the tenth and eleventh ribs were cut across by an osteotome and this allowed a wide separation of the ribs. The hand of an assistant was used to retract the liver upward and this brought into view the ascending colon and its hepatic flexure, the right kidney and the tumor mass (Fig. 2). The parietal peritoneum lateral to the ascending colon was incised for a considerable distance and the colon mobilized and packed off to the left. This pre-

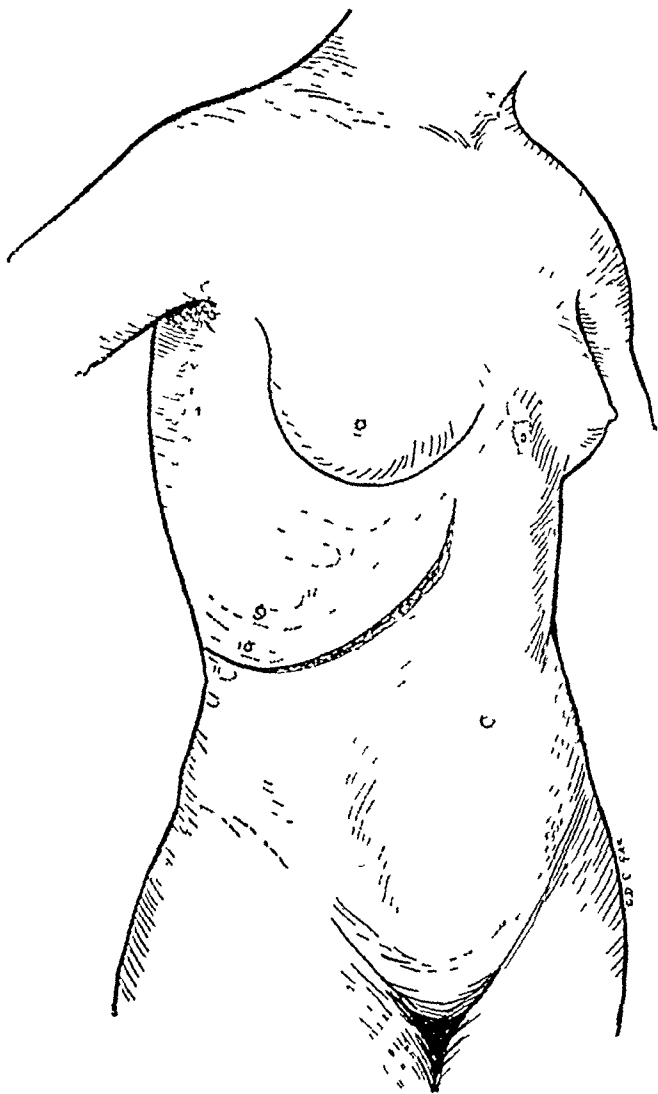


FIG. 1.—Incision to expose the suprarenal body

vented the small intestines from pushing into the operative field and brought the tumor directly into view. It was smooth, almost as large as the patient's kidney and lay immediately above the kidney and in contact with it below and tucked up very close to the under surface of the liver, above laterally it lay against the posterior abdominal wall and mesially it was in close contact with the ascending vena cava for several inches. It was quite firm in consistency, although not of stony hardness, smooth and was surrounded by a somewhat loose outer covering of areolar tissue containing a considerable number of large vessels. Between the mass and the kidney there was a strip of fatty tissue containing vessels that were quite large. The outer covering of the tumor mass was incised and this gave a very good exposure of it. There were a number of large vessels running from

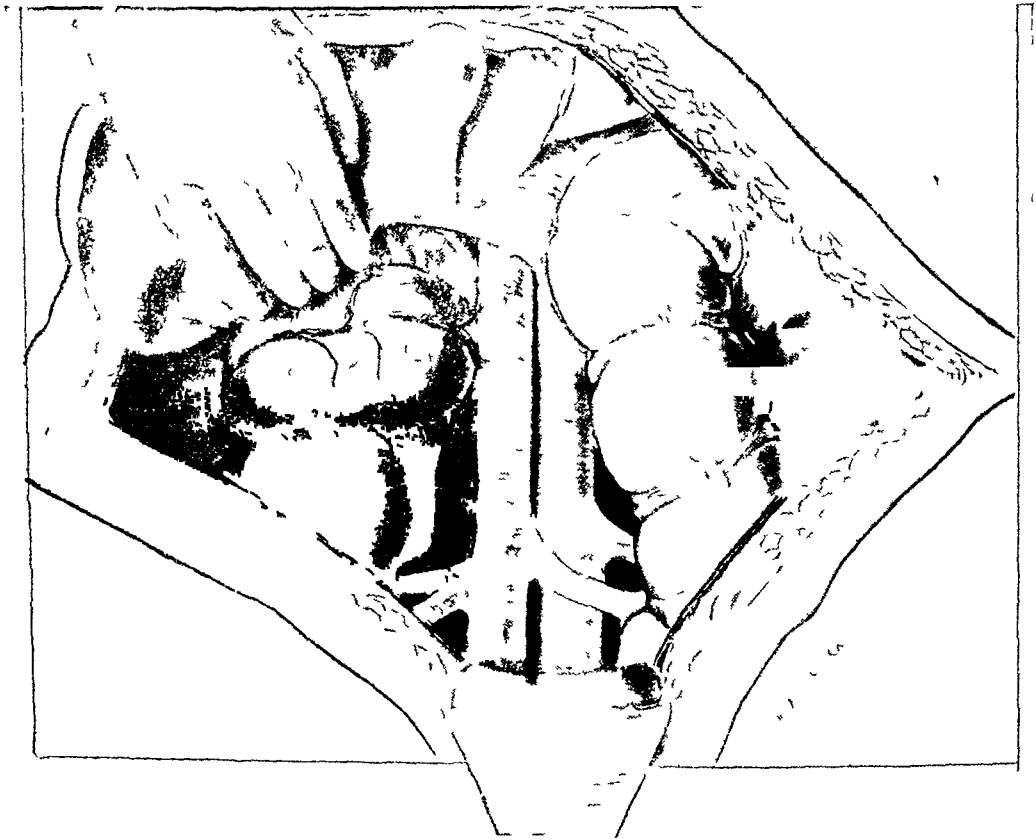


FIG 2—The tumor exposed

this outer layer of loose connective tissue to a dense, smooth capsule intimately adherent to the tumor. The tumor, however, could be separated from its bed and a number of clamps were applied wherever veins were visible. No definite pedicle could be made out. The blood supply was abundant and came into it from a number of directions. The tumor was separated from the surrounding structures and considerable hæmorrhage was encountered in two localities—one below the tumor and between it and the kidney. This hæmorrhage was not difficult to control. The chief return blood supply went from the tumor mass directly into the ascending vena cava at about the level of the middle of the tumor and considerable difficulty was encountered in finding room enough between the tumor and the vena cava to apply clamps. After the tumor (Fig 3) was removed there was some bleeding in this area and a good deal of anxiety was felt in controlling it, as it was feared that the vena cava would be torn. Altogether, the patient lost about eight ounces of blood. The clamps were tied and two cigarette drains were left in position. The duodenum was not seen, it was kept in mind because of its position behind the peri-

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toneum and its relationship to the upper pole of the right kidney and to the right suprarenal. The patient's blood pressure varied sharply during the operation and she was infused on the table with normal salt solution. The wound was closed and she left the table quite shocked.

During the operation a careful record of blood pressure was kept by Doctor Pincoffs. She had no attacks of hypertension just previous to operation nor did any occur during or after operation. Her highest systolic pressure on the operating table was 152, and three other readings of 140, 130 and 138 were made in the early stages of the operation. As the operation progressed the blood pressure steadily dropped until just after the tumor was removed, when it was 88/62. After this the systolic varied between 94 and 110, and just as she left the table was 75. The anesthetization, preparation, operation and dressing occupied one hour and twenty-five minutes. The patient left the table badly shocked and the blood pressure remained very low for several hours after operation. Her condition during this time was critical—well-marked grayish cyanosis, respirations rapid and shallow. She was given a transfusion of about 400 cubic centimetres and stimulated with an ampoule of caffeine sodium benzoate. At the most critical period she spat up a small quantity of frothy sputum containing some bright red blood. She then began to improve and later in the afternoon her condition had improved markedly. By the following morning her condition was good. Throughout convalescence, her blood pressure remained low. The day following operation it was 116/74, the next day 118/64 and from that time until July 10, it ranged between 95/65 and 110/70. She stood this low blood pressure very well.

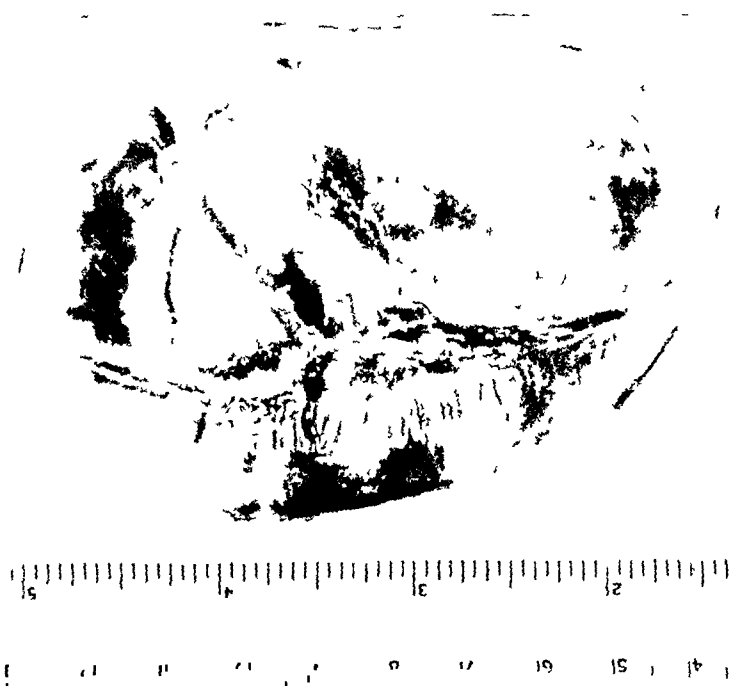


FIG. 3—The tumor after removal.

and had no attacks of hypertension during her stay in the hospital after operation, and reports herself, ten months later, as entirely well and free from attacks.

The only post-operative complication was a rise in temperature and moderate pain in one leg, twelve days after operation. There was very little swelling or tenderness. It was diagnosed thrombo-phlebitis and treated accordingly. In a few days, these symptoms had disappeared.

The pathologist's report, made by Dr. Hugh R. Spencer, is as follows:

Gross—The tumor weighs 115 grams, size 9 × 7 × 3.5 centimetres. It is completely encapsulated. On one side there is an orange-yellow row of tissue, which resembles adrenal cortex. It is soft. The cut-surface is gray in places while in other places it is red and appears hæmorrhagic. Some very small spaces (cysts?) are seen deep in the gross. The yellow tissue mentioned above, on section appears to be adrenal cortex with a very small gray portion, which resembles medulla and which appears to be continuous with the main portion of the tumor. All the yellow tissue is not more than one centimetre wide and two millimetres thick and extends as a narrow strip along one side for almost the entire length. At one place a small orange-yellow mass is found deep in the tumor. This mass is only two to three millimetres in diameter and resembles cortex.

Gross Diagnosis—Tumor of Medulla of Adrenal.

DISCUSSION

Microscopic—Frozen section as stained with scarlet-red (Herxheimer) shows no fatty material in tumor cells. Fatty material is found in abundance in cells of cortex. Tumor tissue fixed in a solution of chrome salts assumes a yellowish color. Sections show a tumor composed of oval and polygonal cells arranged in alveoli separated by capillaries. The nuclei are of various shapes, some are hyperchromatic.

Microscopic Diagnosis—"Paraganglioma"

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DISCUSSION DR GEORGE W CRILE of Cleveland, Ohio, remarked that he had removed the adrenal gland in twelve cases of hypertension. These cases had been followed, some for as long as twelve or ten years.

On the operating table there would be a fall in the blood pressure. This fall would sometimes persist for a few days, or a few weeks and then after that period the blood pressure would run an irregular course. As a whole, he was unconvinced that he produced any results. This report has no bearing on the case that was reported by Doctor Shipley, it is offered only to record a warning that we cannot put too much faith—as Doctor Shipley does not infer—in the fact that this tumor had a certain effect on the blood pressure.

DR ROBERT TALBOT MILLER, JR, of Baltimore, Md, reported a case which possibly has some analogy to the condition described by Doctor Shipley, although the analogy is not quite clear.

It concerned a man of sixty, a very active and intelligent man who had been in the best of health. For a period of a year and a half to two years he had been suffering with attacks of precordial pain and distress and anxiety and was a picture of possible angina pectoris. He was submitted to very careful study and put into the hands of a very skillful internist. The study

was made with the utmost detail. The internist concluded he was suffering from functional angina pectoris. He observed that with each attack the man had an extremely rapid and quite a marked rise in blood pressure, which persisted throughout the attack. He confirmed the previous findings, but was unable to find any reason for these attacks. He found, however, in the right lobe of the thyroid an adenoma, perhaps three cubic centimetres in diameter. The man was utterly miserable and the situation was explained to him. The internist suggested that the adenoma be removed with the hope that it would relieve his condition and he consented.

Doctor Miller took out a normal right lobe of thyroid containing the adenoma. The man was convalescent and out of bed in a little while and since that time has not had an attack. He has apparently recovered completely and is leading an active life.

END RESULTS IN THYROCARDIACS

BY FRANK H LAHEY, M D

OF BOSTON, MASS

THE surgical management of patients with thyroid disease has shown within the last decade a striking—if not the most striking—development that has occurred in the surgical management of any disease. As an indication of the truth of this statement we have but to call attention to the great value of the use of iodine, for the practical application of which we are so much indebted to Dr Henry S Plummer, the elimination for the most part of preliminary pole ligations, the better management and the prevention of non-surgical thyroid crises, the avoidance of severe post-operative reactions, the immediate search for and transplantation of removed parathyroid bodies, as proposed and practiced in our clinic to lessen the possibility of post-operative tetany, the critical elimination of patients with non-thyroid neurotic states as candidates for subtotal thyroidectomy, the lessening of the likelihood of carcinoma of the thyroid by the prophylactic removal of foetal adenomata, the propensity of which to show carcinomatous changes particularly characterized by vessel ingrowth has been so well demonstrated by Dr Allen Graham, the reduction of the operative mortality rates in all organized thyroid clinics to almost trivial figures. In our clinic, during the year 1927, the total operative mortality rate was 0.6 per cent in 954 patients, in the year 1928, the total operative mortality rate was 0.27 per cent in 1068 patients, the mortality rate in exophthalmic goitre 0.15 per cent in 618 patients. In addition, we have the almost universal acceptance of surgery as the method of treatment of toxic goitre, and, finally, the feasibility, as we have proven in our experience, of subtotal thyroidectomy in patients with even seemingly hopeless degrees of cardiac failure due to thyroidism, and the almost miraculous restoration of cardiac capacity which may be obtained by this procedure. We have been particularly interested in this latter group of cases which I have myself, in writing on this subject, grouped under the term “thyrocardiacs”. This term is, from a puristic point of view, quite improper, but nevertheless serves a most excellent purpose in calling attention to this hitherto often overlooked condition as an entity, and particularly as an entity not hopeless but, in large part, relievable.

We were led into this field of what we have called “thyrocardiacs” by feeling the restrictions of further development in the usual field of thyroid surgery, as the result of the advances which have already been enumerated.

Claims of priority usually lead but to conflict, bitterness, and a final realization that in this day and generation there is little that is novel, and even less that is truly new. Therefore, we wish to assert that we have no desire to claim priority in relation to thyrocardiacs, but are particularly prompted by a desire to promote an interest in, and a conception of, this

state which will result in the acquiring of wider ability to recognize it, and a realization that this apparently hopeless condition is capable of being improved to a remarkable degree by subtotal thyroidectomy

As the result of our experience with thyroid disease, we have come to the conclusion that thyroidism in itself does not cause heart disease, and that there is no heart state which can be designated as a true thyroid heart. These conclusions we have had demonstrated to us again and again in observing young people with thyroidism of such a degree that the pulse rates became uncountable. We have observed such young individuals with intense, and eventually fatal, degrees of thyroidism over considerable periods of time, yet at no time—even up to death—has there been present in these young persons any cardiac decompensation. They have not shown orthopnea, they have been able to lie flat in bed without respiratory embarrassment, they have had no edema, and they have shown no enlargement of the liver. Furthermore, there has never been presented in the laboratory nor in the literature any convincing evidence that thyroidism in itself ever produced any selectively destructive effect upon the heart.

We believe that the cardiac states, auricular fibrillation and cardiac decompensation, so often associated with thyroidism, are, therefore, not due to a destructive effect of thyroidism upon the heart which is unable to withstand the excessive burden of the superimposed drive of hyperthyroidism. Auricular fibrillation and heart failure result, and the individual then falls into the group which we have called "thyrocardiacs."

The observation that auricular fibrillation and cardiac decompensation, associated with thyroidism, occur most commonly in patients of middle age and, particularly, later life, and very rarely in young individuals, further suggests that the explanation of cardiac failure associated with thyroidism is the preexistence of a damaged or of a handicapped heart.

It is important to establish this conception of the cause of cardiac failure associated with thyroidism, since it permits of a reasonable explanation of why failure occurs, why patients, in what appear to be hopeless states of cardiac decompensation, successfully endure general anaesthesia (ethylene) and a major surgical operation. It explains why, by subtotal thyroidectomy, which removes the superimposed cardiac burden (thyroidism with its excessive drive), it is so possible to restore cardiac compensation, and why, by elimination of this extra cardiac burden, seemingly hopeless individuals regain surprising degrees of cardiac capacity and an ability for general activity.

The diagnosis of thyroidism associated with and resulting in heart failure is not the simple accomplishment it may seem, particularly since the more severe and urgent the symptoms of cardiac failure, the more obscured and overshadowed are the symptoms of thyroidism.

One of the reasons why it is often difficult to recognize thyroidism associated with heart failure is because of the fact that the symptoms of thyroidism in these elderly patients are usually not those of activation, as so typically

occurs in young persons, but rather the apathy which so frequently appears with thyroidism occurring in older individuals

With opportunity to observe several thousand cases of thyroidism and their response to conditions of stress we have had it impressed upon us that there are two opposing types of reaction to thyroidism. First, that of activation, which so commonly occurs in young people, with the classical picture of the disease, doubtless the response of the vigorous, energetic, alert organism of youth and early adult life to the intoxication, and secondly, apathy—the more sluggish, quiescent, indolent response to the intoxication—which occurs in individuals occasionally in late middle life, but more often in later years with less vigorous and less responsive organisms, also due possibly (although it is unlikely) to a different kind of thyroid intoxication.

We have particularly called attention to this apathetic type of thyroidism in connection with cardiac decompensation, with which it is so commonly associated, and I would state from our contact with this type of reaction, for the benefit of those who have not been impressed by, nor appreciated, the existence of this condition, that in any form of thyroidism, exclusive of its association with cardiac decompensation, it is the more dangerous of the two states of thyroid reaction. It occurs in individuals with less capable organisms, and, since it is less striking and less direful in appearance, it tends to lead one who has activation in mind, as an index of toxicity, into a false sense of complacency, or a complete oversight of the presence of such a potentially serious thyroid situation. A failure to appreciate the unobtrusive dangers of this apathy of varying degree in thyroidism has not infrequently in the past been—and even still threatens to be—the explanation of at least a part of an ever-present, even though trivial, mortality in the surgery of thyroidism.

We have now operated upon 138 patients who would fall into the group which we have designated as thyrocardiacs, and of this group five died while still in the hospital, an operative mortality rate of 3.6 per cent.

The causes of death in these five patients who succumbed while still in the hospital were as follows. One patient died of post-operative mediastinitis following the removal of a toxic retrotracheal goitre in the presence of severe decompensation, one, forty-five years of age, died of status lymphaticus, as proven by autopsy, one died of probable pulmonary embolism, and two died sudden deaths of unknown origin, no autopsy being permitted.

There were four cases in which operation was not done,—one dying of bronchopneumonia before operation, one toxic patient with hopeless malignancy, one dying of tracheal obstruction before operation, and one patient who refused operation.

Of the operated cases, twelve cases have died since operation, after leaving the hospital.

Four died with congestive heart failure,
Three died sudden deaths,
One died of pneumonia,
Four died of undetermined causes

END RESULTS IN THYROCARDIACS

It is presumed, then, that of the entire group here considered,

One hundred and one are living,
Eighteen are untraced,
Five died operative deaths (while still in the hospital),
Twelve have died since operation (see types of death above),
Two died of causes other than heart, after leaving hospital,
Four were not operated upon,

making a total of 142 cases considered in this end result study

It has frequently been suggested that cardiac complications were more apt to occur in patients with toxic adenomata or secondary hyperthyroidism than in those with exophthalmic goitre or primary hyperthyroidism. As evidence that these suggestions are not true, of the pathological reports on the tissue removed (except in the four cases in which operation was not done, in which a clinical diagnosis was employed) forty-nine were adenomatous goitres, or secondary hyperthyroidism, and ninety-three were exophthalmic goitres, or primary hyperthyroidism. I do not believe that there is any difference in the toxicity associated with adenomatous goitre and that associated with exophthalmic goitre and its relation to cardiac complications. As is the case in this study, I believe that the type of toxic goitre which predominates in the community in which the surgery is done will predominate in the figures of that study.

It is of interest to observe that the average duration of cardiac symptoms before operation, as given by the histories in this study, was two and one-half years, and that the average number of years during which the ninety-five patients have been well and active after operation is three and one-half years.

The post-operative end result in cardiac function in the 101 traced thyrocardiacs is as follows

Full return to former activity	95
Persistent auricular fibrillation	19
Partially disabled	4
Completely disabled	2

Of the 138 operated cases, forty-six were done in two stages, two have been operated upon for recurrent hyperthyroidism, and three are known still to have persistent hyperthyroidism.

Fifty-five patients had mild failure, fourteen moderate failure, and forty-two severe failure. Under mild failure were grouped those patients having oedema and marked dyspnoea on attempted activity. Under moderate, those patients having oedema, enlarged liver, orthopnoea, requiring rest in bed and active treatment. Under severe, those patients with anasarca, hydrothorax, large liver, orthopnoea and dyspnoea at rest, and requiring intensive medical treatment.

The incidence of auricular fibrillation (established, not transient) in the 142 cases before operation was as follows

FRANK H LAHEY

Established auricular fibrillation	122 cases 85.9 per cent
Paroxysmal tachycardia	2 cases 1.4 per cent
Normal rhythm	18 cases 12.6 per cent

Of the 142 patients in this study, there was present

Auricular fibrillation with clear-cut congestive failure in	92 cases
Auricular fibrillation without clear cut congestive failure in	30 cases
Normal rhythm with congestive failure in	18 cases
Paroxysmal tachycardia with congestive failure in	1 case
Paroxysmal tachycardia without congestive failure in	1 case
	—
	142

The age distribution of the group is as follows, demonstrating, as we have often stated, the inclination of the thyrocardiac state to occur in later life, and in hearts which are handicapped or crippled

Age	Number
20—29	1
30—39	17
40—49	37
50—59	56
60—69	27
70—75	4
	—
	142

SUMMARY

Attention is directed to apathy in contradistinction to typical activation as a frequent indication of thyroidism in thyrocardiacs and thyroidism of later life

The mortality (total hospital) of 138 operated thyrocardiacs, ninety-three of whom were in varying degrees of congestive failure, was 3.6 per cent (Five deaths)

The average history of symptoms (heart) before operation was two and one-half years, the average period during which patients have been well and active after operation had been three and one-half years

The fact that, with the exception of the four cases mentioned in the text (two dying in the hospital before operation, one rejected because of an inoperable malignancy, and one refusing operation herself), every thyrocardiac coming to the clinic was operated upon, and practically every one with a general anæsthetic (ethylene), indicates that there are essentially no thyrocardiacs who are too decompensated to withstand subtotal thyroidectomy without an undue risk

Of the 101 patients traced, and living, an average of three and one-half years after operation, but two are completely disabled, four partially disabled, ninety-five have been returned to the full function which they possessed before the onset of hyperthyroidism

DISCUSSION DR GEORGE W CRILE of Cleveland, Ohio, presented figures from Doctor Anderson of his Cardiologial Department They found in their series that no relation has been established between extra systoles and the thyroid gland before or after operation, paroxysmal tachycardia bears little or no relation to goitre, in essential hypertension there is little or no relation, in the case of auricular flutter a definite relation to goitre is quite rare

Auricular fibrillation is the most frequent cardiac disturbance He did not know if one could include that in the thyrocardiac group Of 150 cases, all of which had an electrocardiographic record made before and after operation, 65 per cent were restored to normal rhythm and 35 per cent showed no effect

Of the 150 cases there were six deaths, or 4 per cent Doctor Lahey reports 3.6 per cent

Finally, a mitral systolic murmur is a frequent accompaniment of hyperthyroidism and usually disappears after the operation

CHRONIC FIBROUS OSTEOMYELITIS

By DALLAS B. PHEMISTER, M D

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FROM THE DEPARTMENT OF SURGERY OF THE UNIVERSITY OF CHICAGO

CHRONIC fibrous osteomyelitis is a term that may be applied to any long-standing pyogenic infection of the bone in which the reaction on the part of the fibroblasts in contrast with the infiltrative cells becomes the outstanding feature of the lesion. As is well known, it may come as the end stage

of acute pyogenic osteomyelitis in which there has been suppuration, necrosis, absorption, and cavity formation. As repair takes place the cavity may be filled with fibroblastic tissue showing varying degrees of maturation. Brodie's abscess not infrequently becomes quiescent or heals in this way. Such an area of chronic fibrous osteomyelitis may remain symptomless for an indefinite period or it may produce mild disturbances or be the seat of acute exacerbations.

There is usually more or



FIG 1.—Chronic fibrous osteomyelitis of acromion process

less osteosclerosis with the formation of a bony shell about it. Gradual replacement by hæmopoietic and fatty marrow may ultimately come about.

In contrast with this condition we may see a form of osteomyelitis pursuing a chronic course from the onset in which a circumscribed area of bone is broken down by fibroblastic activity and the space filled up with soft tissue. This lesion deserves special consideration since by the time that it has come to operation it is devoid of the usual microscopic changes of pyogenic infection and bears much resemblance to benign giant-cell tumor and osteitis fibrosa cystica with which it is sometimes confused. I have studied eleven cases belonging to this group particularly from the pathological standpoint. The findings vary greatly according to the age of the lesion. In those cases operated on during the first few months, while the disease is progressive, the

CHRONIC FIBROUS OSTEOMYELITIS

cavity has been found to be filled with a soft tissue that is grayish to brown in color. Microscopically it consists of fibroblasts, capillaries, polyblasts, giant cells, old hæmorrhage, and blood pigment. There is usually more or less necrosis throughout the tissue. Cholesterol slits are sometimes seen. There is lacunar absorption about the walls of the cavity and the adjacent haversian canals are dilated as a result of absorption by newly-formed fibrous tissue. There is practically no leucocytic or lymphocytic infiltration to be seen. The response on the part of the



FIG. 2.—Tissue removed from lesion shown in Fig. 1

surrounding bone is extremely variable. In some instances little or no bone is laid down, while in others, there is marked new bone formation.

The following case is one in which there was bone destruction with practically no surrounding new bone formation. Female, thirty years of age. Six months before admission she began to have pains in the region of the acromion process of the right scapula. They gradually increased in severity and she developed moderate limitation of motion in shoulder. No general symptoms. Examination was essentially negative aside from the region of the right acromio-clavicular joint which was painful on motion and tender on pressure. There was no swelling. A roentgenogram (Fig



FIG. 3.—Destructive lesion (A) of parietal bone

1) revealed destruction of the mesial half of the acromion bordering on the acromio-clavicular joint. No new bone formation. Wassermann negative. At operation the acromion process for approximately one centimetre about the acromio-clavicular joint was missing and the space was filled with soft granulation tissue which bled freely. It was curetted away and the adjacent bone was removed with rongeur forceps. The wound healed *per primum* and six months later the disease appeared to be healed on physical and X-ray examinations. Microscopic examination showed the excised tissue to be composed very largely of fibroblasts with many capillaries, a few giant cells, and monocytes. (Fig. 2) There were areas of

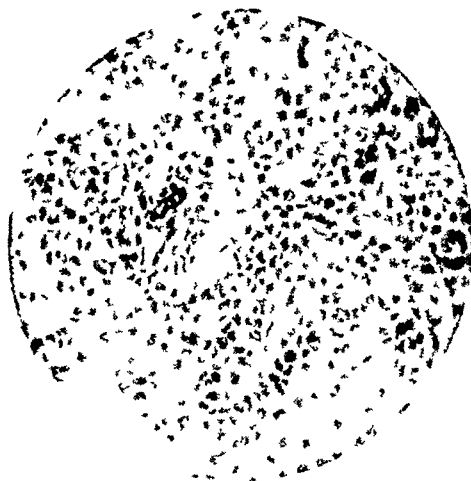


FIG. 4.—Photomicrograph of tissue removed from lesion shown in Fig. 3

necrosis and occasional polymorphonuclear leucocytes There were a few small trabeculae of bone undergoing lacunar absorption

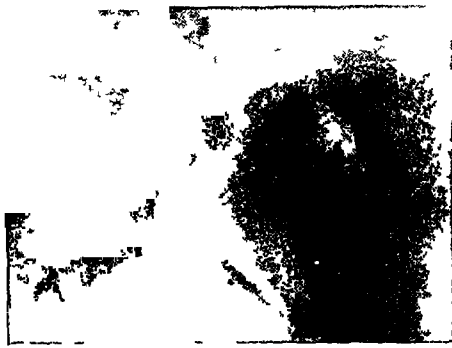


FIG 5—Showing a cavity in posterior part of ilium with thin, sclerosed walls

inch in diameter without accompanying new bone formation A grayish-brown tissue was curetted from the cavity by Dr J C Clarke and the lesion healed promptly and has remained so for two years Microscopic examination showed it to be made up mainly of young fibroblasts Throughout were scattered numerous mono- and multinuclear giant cells and blood pigment (Fig 4) There were very few lymphocytes and polymorphonuclear leucocytes This is the earliest lesion of the group No bacteriological examination was made

In other cases a shell of bone is gradually laid down about the cavity which becomes stationary in size, although the disease may remain active and continue to produce symptoms The following case is an example of this type Female, nineteen years of age, gave a history of pain in the left posterior iliac region of nine months' duration It came on while there was an open wound of the right shin and had varied in intensity at intervals No general

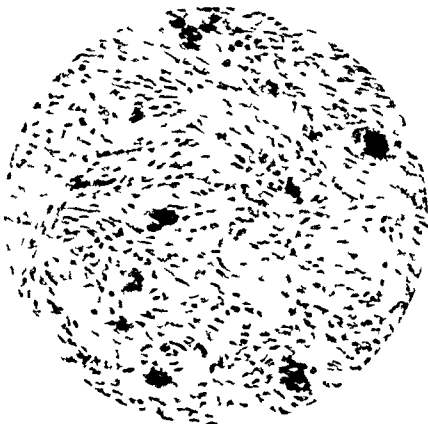


FIG 7—High power of tissue shown in Fig 6

Cultures of the material on aerobic blood agar showed no growth Those on meat broth and milk showed staphylococcus aureus The fact that the histological picture was that of a fibroblastic reaction and that infiltrative cells were present in such small numbers raises the question of whether or not the staphylococcus found in the cultures was a contamination Guinea-pig inoculations were negative for tuberculosis

A similar lesion in a girl, twelve years of age (Bone Sarcoma Registry No 854), was studied pathologically She had had slight pain and a swelling in the occipital region for two months A roentgenogram (Fig 3) revealed a punched out area of bone destruction about one



FIG 6—Photomicrograph of brown tissue from cavity shown in Fig 5 It consists of fibroblasts, immature connective tissue, giant cells and blood pigment

symptoms She had been treated elsewhere for sacro-iliac strain Examination was negative aside from slight tenderness over the upper part of the ilium bordering on the left sacro-iliac joint A roentgenogram (Fig 5) revealed an area of reduced density in the ilium near the sacro-iliac joint with a sclerosed cortex about it At operation the cavity was found to be filled by fibrous tissue which was grayish in some regions and a mottled brown in others, giving it the gross appearance of the "brown tumor" of the Germans There was a shell of cortical bone about it Microscopic examination of the brownish tissue (Figs 6 and 7) showed that it was made up largely of fibroblasts There were many large and small giant cells and a large amount of old blood and blood pigment Few infiltrative cells

CHRONIC FIBROUS OSTEOMYELITIS

were present. The grayish areas were composed of wavy connective tissue in varying stages of organization (Fig 8). No bacteriological examination was made. The lesion healed and the patient was well four years after operation.

When the lesion is situated along the course of the shaft of a long bone whether centrally or peripherally, there may be very extensive new bone formed about the cavity. The cavity may continue to enlarge slowly and the new bone increase in amount over a considerable period of time. In the following case, the lesion began subperiosteally. Male, fifty years of age, two years before admission began to have dull pain in the mesial side of the upper third of the right tibia. It grew steadily worse and after four

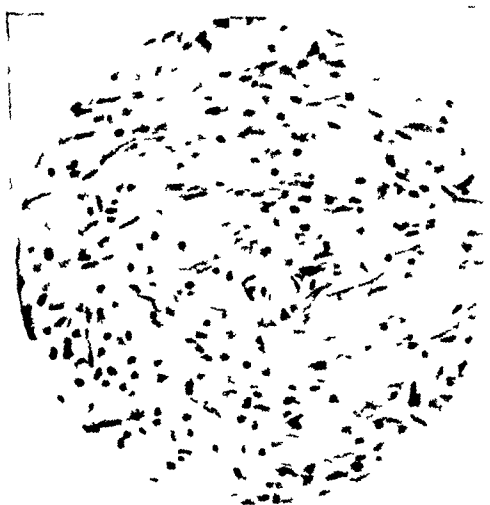


FIG 8—Photomicrograph of gray tissue from cavity shown in Fig 5

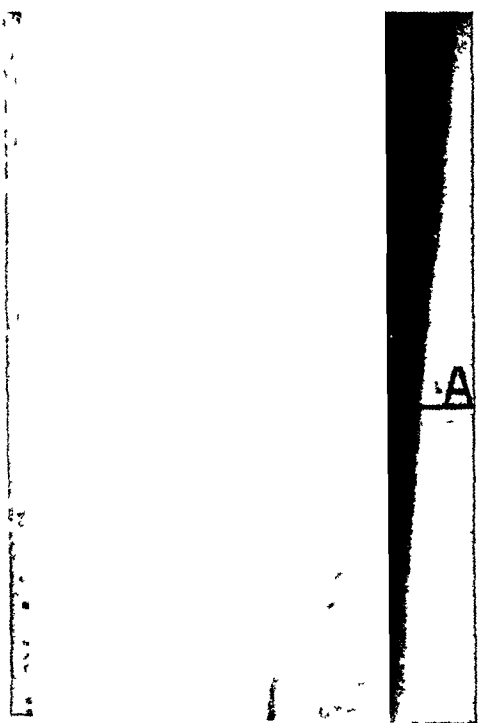


FIG 9—Peripheral lesion with central cavity (A) and marked osteosclerosis about it

months a small tender swelling was noticed. The swelling, pain, and tenderness slowly increased despite the fact that he had four months of antisyphilitic treatment preceding admission. Examination was negative aside from a slightly tender oval swelling extending on the mesial surface of the right tibia five inches below the knee. A rontgenogram (Fig 9) revealed a dense oval shadow along two inches of the surface of the shaft with a small oval area of reduced density in the cortex, at the centre of the swelling. He furnished X-rays taken ten and seventeen months after the onset showing the gradual increase in amount of periosteal new bone and enlargement of the cavity. Wassermann negative. The entire lesion was excised at operation and the cavity was found to be filled with a grayish-brown soft tissue. Aerobic and anaerobic cultures made on blood agar plates gave no growth. Microscopic examination of the tissue removed from the cavity (Fig 10) showed it to be made up largely of fibro-

blasts. There were also many small and a few large giant cells and polyblasts. Extremely few leucocytes were seen. There were scattered areas of blood pigment and extravasated red blood cells. Very fine trabeculae of new bone were seen in the peripheral portion of the tissue. The surrounding new and old bone possessed large cancellous spaces which were filled with fibrous marrow and there was evidence of bone absorption along the wall of the cavity.

This lesion was still in the progressive stage and at the time of operation was producing more marked symptoms than at any time previously. Despite these facts there was almost complete absence of leucocytic infiltration such as would be expected in a pyogenic infection. The patient

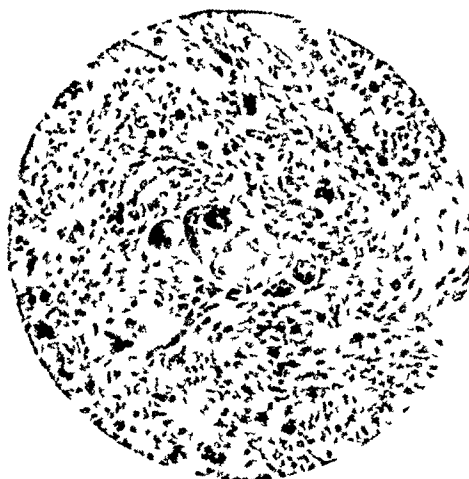


FIG 10—Contents of cavity in Fig 9



FIG 11—Shadow of dense bone about fibrous area, in medullary cavity

ing wavy fibres and almost free from giant cells and blood pigment (Fig 14) There were no leucocytes The contents of the cavity appeared to be in a quiescent stage These two cases might perhaps as well be classed as sclerosing osteomyelitis but the fibrous nature of the reaction at the point of onset of the lesion is the pathological feature of greatest importance

After a progressive period which may extend over a number of months or years, the disease may come to a standstill or healing take place, in which event a cortex is laid down about the lesion and the cavity becomes filled with a mature connective tissue that is free from giant cells and blood pigment This connective tissue may remain unossified or there may be fine bony trabeculae laid down throughout it, particularly in the peripheral regions Some of these lesions produce very few or even no symptoms at the onset and all are apt to become symptomless as the reparative stage is reached Consequently they may be detected as unexpected findings in roentgenograms made because of trivial complaints

was completely relieved by the operation and was well one year later

An example of marked sclerosis in lesion situated in the medullary canal is that of a female, twenty-three years of age, who had pain in the lower end of the shaft of the right tibia for three months without any general disturbance Examination was negative aside from tenderness along the shaft of the tibia just above the epiphysis A roentgenogram (Fig 11) revealed a large, oval, dense shadow extending into the medullary cavity from the lateral cortex of the lower two inches of the diaphysis In the lateral view (Fig 12) an area of reduced density is seen at the centre of the shadow The sclerosed area was excised by Dr John Hodgen The specimen consisted of lateral cortex of the tibia and an oval mass of densely trabeculated bone attached to its inner surface There was a central cavity one by two centimetres in diameter (Fig 13) which was filled with a grayish soft tissue On microscopic examination it was found to be loose connective tissue contain-

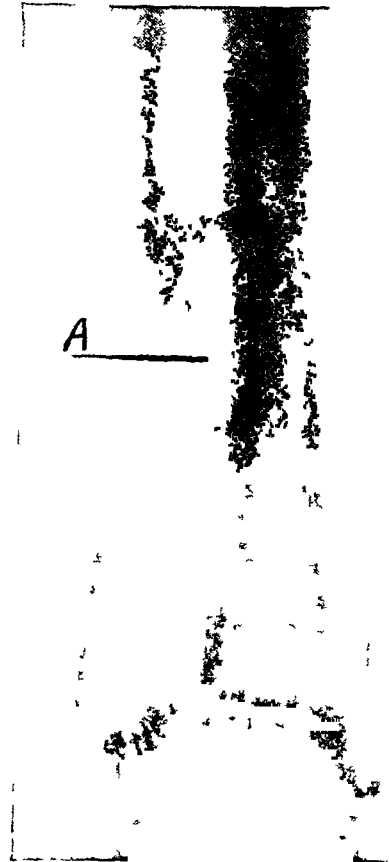


FIG 12—Lateral view of lesion in Fig 11, showing reduced density at seat of cavity in central portion (A)

The following two cases were detected as a result of X-ray examination because of symptoms suggestive of mild arthritis of the knee. A ten-year-old girl had had slight pains in the right knee



FIG 13—Excised lesion shown in Figs 11 and 12 with central cavity (A)



FIG 14—Photomicrograph of tissue from cavity shown in Fig 13

at intervals, for two months. Physical examination was negative. A roentgenogram (Fig 15) showed an oval area of reduced density in the lateral portion of the femur three inches above the knee. Pathological examination of the excised lesion revealed a dense bony shell and mature white fibrous connective tissue filling out the cavity (Fig 16). There were no areas of necrosis or hæmorrhage and practically no signs of phagocytic activity indicative of active inflammation. A similar case was that of a thirteen-year-old girl who for one year had had mildly intermittent pains in both knee-joints. There had been no general symptoms. Physical examination revealed slight tenderness on the mesial side of the right knee. The joint appeared otherwise normal. A roentgenogram (Fig 17) unexpectedly disclosed an oblong area of reduced density (a) in the shaft of the right fibula near its upper end. There was a dense narrow shadow



FIG 15—Cavity filled with fibrous tissue and surrounded by sclerosed wall

about it indicative of bony encapsulation. The shaft of the fibula in the involved region was resected subperiosteally. On longitudinal section the segment was found to contain an oblong area filled with grayish-white soft tissue which was surrounded by a dense

narrow cortex of bone (Fig 18). Microscopic examination showed the cavity to be filled with loose white fibrous connective tissue. There was a small amount of blood pigment to be seen but no giant cells or infiltrative cells. Along the bony wall there was an occasional osteoclast producing bone absorption, but in other places newly-formed bony trabeculae were seen in the fibrous tissue (Fig 19). It is impossible to state when this lesion had developed, but it was apparently in a quiescent state and had it been left alone, would probably have produced no disturbance in the future. Cultures of the soft tissue were made on aerobic and anaerobic blood agar plates, Rosenow's media, deep shake agar tubes and plain broth. They remained sterile.

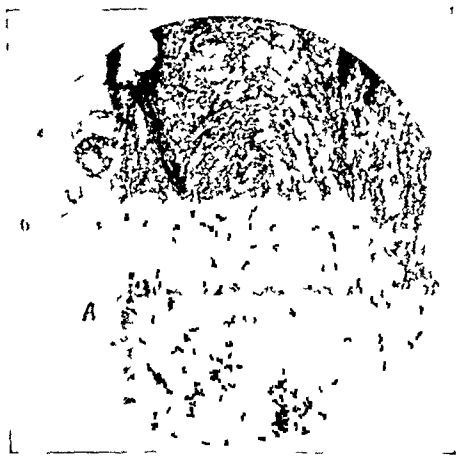


FIG 16—Photomicrograph of sclerosed bony wall (A) and of fibrous contents of cavity shown in Fig 15

Since we do not know the pathology of the very early stages of these lesions it is impossible to say whether they began as ordinary pyogenic inflammatory processes or whether the changes here observed were continuous throughout the entire progressive period of the lesion. But the fact that those operated on during the active period showed no leucocytic or lymphocytic infiltration favors the latter view. The tissue filling the cavity during the active stage bears some resemblance to that lining the cavity of a bone cyst, and its brown areas containing giant cells resemble giant-cell tumor which Barrie called hæmorrhagic osteomyelitis. The localizing tendency and the sur-



FIG 17—Cavity (a) with sclerosed wall in medullary canal of fibula

rounding osteosclerosis are much less consistent with bone cyst and giant-cell tumor, than with pyogenic osteomyelitis. Osteitis fibrosa cystica may heal by filling out of the cavity with fibrous tissue and subsequent incomplete ossification very similar to the end stage seen in some of these lesions.

The etiology of the eleven cases that have been observed has been very



FIG 18—Photograph of section of fibula of Fig 17, showing cavity filled with grayish fibrous tissue and surrounded by a bony cortex.

imperfectly investigated. There appeared to be nothing in the histories that had any bearing on the cause except the infected open wound on the leg in the case of involvement of the tibia, which may have been the portal of entry of the microorganism. In four cases no bacteriological examination was made. In two



FIG 19—Photomicrograph of bony wall (a) and of fibrous contents of cavity (b) shown in Fig 1.

cases *Staphylococcus aureus* grew in the cultures. In the remaining five cases the cultures remained sterile, but in only two were both aerobic and anaerobic cultures made that might have permitted the growth of any form of pyogenic organism. Konjetzny (*Archiv für Klinische Chirurgie*, vol cxxi, p 567, 1922) and Losser (*Deutsche Zeitschrift für Chirurgie*, vol clxxxv, p 113, 1924) regard so-called brown tumors as the result of hæmorrhage that sets up an active absorptive process within the bone. However, the absence of a history of traumatism and the nature and duration of the changes are entirely inconsistent with an explanation on a purely traumatic basis. Axhausen (*Archiv für Klin. Chir.*, vol cli, p 72, 1928) has described anæmic infarcts of bone. He believes that in the process of organization of such areas there may be connective tissue invasion of the necrotic field with absorption, hæmorrhage, and cyst formation or fibrous tissue replacement with the establishment of connective tissue islands similar to those observed in some of the cases here described. It is possible that embolism and infarction play a rôle in the production of some of the lesions in this group as the last three described, but bacterial infection must also be present as the clinical manifestations in some cases and pathological changes could not be accounted for on the basis of aseptic necrosis alone.

The most probable explanation of these lesions appears to be that they are produced by organisms of low virulence belonging to the pyogenic group but not setting up the usual cytological reaction of pyogenic inflammation. This is rendered more plausible by the fact that *Streptococcus viridans* has

grown in cultures of bone cysts and osteitis deformans and it has been cultivated from inflammatory changes in rheumatism, such as the Aschoff bodies of the heart and the nodules in the skin in which fibroblasts, giant cells, and polyblasts may predominate over leucocytic cells. They constitute a borderline group of lesions which require further investigation from an etiological standpoint but their pathological and clinical characteristics warrant us in retaining them as a sub-head of chronic osteomyelitis. Some of them may be organized infarcts infected by microorganisms of low virulence.

RETROCECAL INTERNAL HERNIA

By WILLIAM B. COLEY, M.D.

AND

JOSEPH P. HOGUET, M.D. (By Invitation)

OF NEW YORK, N. Y.

RETROPERITONEAL hernia is a very rare condition, only a small number of cases have been reported in the literature. Loid Moynihan¹ in his Arris and Gale lecture on "The Anatomy and Surgery of the Peritoneal Fossæ" gives us the most lucid and detailed description of this condition. The most common form of retroperitoneal hernia occurs in the duodenal fossæ. These fossæ were mentioned by Hensing² in 1742 and also by Waldeyer³ (1868), who made a very careful study of the anatomy of the peritoneal fossæ and published an excellent description thereof.

As to the origin of these fossæ, Treitz⁴ attributes their existence to the embryonic movement of the intestinal canal. Waldeyer suggests a vascular theory, based upon the idea of the close relationship of the fold and the inferior mesenteric vein. According to Treves,⁵ the inferior duodenal fold represents the remains of the mesoduodenum. He states "More peritoneum is required by the cæcum and ascending colon, and it is obtained from that of the posterior parietes, and in great measure by the unfolding of the mesoduodenum." Moynihan holds that these folds are to be regarded as *fusion folds* between the original left, afterward anterior, surface of the ascending portion of the duodenum and the right or anterior surface of the descending mesocolon folds, which date their origin from the time when these two peritoneal surfaces are in close apposition. Such a time is at the end of the third or the beginning of the fourth month. According to Toldt⁷ it is only in the eighth month of intra-uterine life that the folds are formed, although, in one of his figures he shows the folds quite distinctly developed in the fifth month.

In his publication of 1897 Moynihan had collected fifty-seven cases of left duodenal hernia, to which, in his second edition of 1906, he added sixty-three cases more.

The ileocolic or ileocæcal hernia is much more rare. Santorini⁸ in 1775 first described the fossa in this region. According to Moynihan no further mention was made of it until 1834 when Huschke⁹ described two fossæ bounded by three folds, made evident by traction on the vermiform appendix. In 1857 Treitz¹⁰ described a third or "subcæcal" fossa. In regard to this Moynihan quotes Treitz, as follows: "Sometimes there is but a trivial excavation, at other times there is a sac the length of the finger, the fundus of which lies between the two layers of the ascending mesocolon. The orifice looks downward and to the front toward the free extremity of the cæcum,

which it is necessary to lift up in order to expose the fossa " It would seem that our own case belongs to this variety

Moynihan describes the folds and fossæ as follows *Primary folds* (1) The ileocolic (or anterior vascular) fold, (2) The accessory ileocolic fold, (3) The ileo-appendicular fold, (4) The meso-appendix (mesenteriolum, posterior vascular fold)

The fossæ formed by these are (1) The ileocolic fossa, (2) The accessory ileocolic fossa, (3) The ileo-appendicular fossa

With regard to the retrocolic or retrocæcal fossa (*fossa cæcalis*, Huschke, Waldeyer, *fossæ post-cæcalis*, Tarenetzky, *subcæcal* fossa, Lockwood and Rolleston, *retrocæcal* fossa, Jonnesco, *retrocolic* fossa, Treves, Berry, *retro-versio hypogastrica dextra seu inferior dextra*, Gruber, *recessus retrocolicus*,

Brosike), Moynihan believes that, on the whole, the most accurate name for this fossa, and the one which he adopts, is *retrocolic* He states "In order to see the pouch it is necessary to turn the cæcum upward There will then be exposed a fossa of variable size and capacity situated behind the cæcum and the lower part of the ascending colon In some cases the whole length of the index finger can be comfortably laid in a sort of peritoneal tube which extends upward to the kidney"

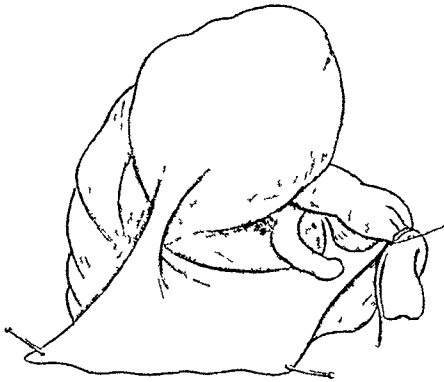


FIG 1—Retrocæcal hernia Moynihan

In discussing the frequency of this condition, Treitz¹¹ refers to but two examples the case of Snow¹² and that of Wagner¹³ The latter case Moynihan does not accept as authentic He states that "Many of the cases recorded as examples of retrocolic hernia, and accepted by most authors, including Jonnesco, cannot be regarded as authentic" He reviews sixteen such cases and gives the reasons for excluding them

Relative to the symptoms, diagnosis, and treatment of pericæcal hernia Moynihan states as follows

"As might be expected, a hernia into one of the fossæ around the cæcum does not actually give rise to symptoms unless strangulation occurs

"Among the recorded cases, in but two (Atherton and Mansell Moullin) was any history of previous abdominal symptoms obtained

"In Atherton's case the patient complained of pain and soreness in the lower part of the abdomen on the right side These symptoms led to a diagnosis of chronic appendicitis, and the removal of the appendix After the operation the patient developed acute intestinal obstruction, due to the strangulation of a loop of ileum in the retrocolic fossa

"In the case recorded by Mansell Moullin the patient gave a history of four previous attacks similar to the one which proved fatal

"In the large majority of cases the symptoms are those of acute intestinal strangulation of intestine, sudden severe abdominal pain, followed by vomiting, absolute constipation, and rapidly increasing distention of the abdomen

"As a rule there are no means of arriving at an accurate diagnosis In some cases resistance has been felt on palpation over the right iliac fossa

RETROCÆCAL INTERNAL HERNIA

"In one case (Mansell Moullin) a fairly well-defined swelling could be felt, rounded above

"Of the cases recorded, laparotomy has been performed in eight, with four recoveries and four deaths. The fact that in two of the four fatal cases (Nasse and Funkenstein) the cause of death was the inhalation of vomit, is an instructive comment on the necessity of washing out the stomach in cases of intestinal obstruction, before operating"

In operations of today it will be seen that the latest method of spinal anæsthesia would be the method of choice in such cases

CASE—(COLEY-HOGUET) T P, male, thirty-nine years of age, a carpenter, consulted Doctor Coley in August, 1928. He gave a history of having had occasional attacks of abdominal discomfort, chiefly on the right side, over a period of six or eight months. The feeling of fullness in the abdomen his family physician had attributed to gas. This discomfort slowly became more and more marked until at the end of five or six months the patient was unable to carry on his regular work. There was no loss of weight, and most of the time he was able to be up and about. The attacks of discomfort seemed to bear no relationship to his diet or exercise, they were most noticeable on lying down.

On careful physical examination Doctor Coley found a man of medium height, weighing about 150 pounds. His general appearance was that of a healthy individual. Examination of the abdomen



FIG 2—Showing relations of caecum and ileum to posterior peritoneal pouch

(prone position) showed no distention. Palpation failed to reveal any external hernia or any intra-abdominal tumor. On the right side—the side on which he had discomfort—midway between the costal arch and the crest of the ilium, on pressing down Doctor Coley could feel distinctly the sensation of bowel or omentum slipping through a ring, then on releasing the pressure he could feel the same bowel or omentum returning. It gave one the exact sensation of reducing a moderate size scrotal hernia through the inguinal ring, which required very little pressure for reduction and which, on releasing it, the sac would again refill, only the process was reversed. After several careful examinations Doctor Coley came to the conclusion that in the present case we were dealing with a retroperitoneal hernia which, when the bowel or omentum entered the sac, caused the discomfort described. Doctor Coley advised an operation. The patient was sent to the Hospital for Ruptured and Crippled, where a series of roentgenograms proved negative. Doctor Coley had a number of his colleagues examine the patient, telling them his opinion in advance, but he could get none of them to agree with it. They did agree, however, that inasmuch as the patient was suffering from some condition in the abdomen, which prevented him from carrying on his work, one was justified in performing an exploratory

operation I was called away from town at this time and turned the patient over to my son, Doctor Hoguet and Doctor Bradley L. Coley for operation. This they performed on August 17, 1928, and their description of the procedure follows:

Operation—It was thought that there might be a deficiency in the abdominal wall



FIG. 3.—Retrocaecal peritoneal pouch containing coil of ileum and the appendix.

so a right pararectal incision was made with its centre at about the umbilicus. The fascia of the external oblique and the anterior sheath of the rectus was found to be very much thinned out in the lower half of the wound, but there was no true hernia. A long, slightly inflamed appendix was found lying in a pouch of peritoneum. This was about the size of a grape fruit. Its walls extended upward and were attached to the sides and front of the caecum at about two inches from its lower end (Figs 2 and 3). There was an opening about two inches in diameter in the anterior wall of the pouch through which about six inches of terminal ileum had herniated into the pouch. This ileum was pulled out, the walls of the pouch were cut away, and the appendix removed in the ordinary way. On account of the weakness in the abdominal wall it was closed by overlapping the fascia.

The patient made an uneventful recovery and is in good condition at the present time (May, 1929), nine months after the operation.

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ACUTE ABDOMINAL PAIN, ASSOCIATED WITH SPINAL CORD SHOCK

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THAT *acute*, even agonizing *abdominal pain*, accompanied by rigidity and vomiting, is at times *associated with injuries to the spinal cord*, or its nerve roots, is apparently not duly appreciated. The object of this paper, therefore, is to stress the fact that these symptoms may be due entirely to the nerve injury and that there need not necessarily be any injury to an abdominal viscus to account for such an occurrence. The following case forcibly impressed me with the importance of the necessity of recognizing the above facts.

CASE I—A man, thirty-two years of age, was admitted to the surgical service of the Presbyterian Hospital April 2, 1927, having fallen a distance of fifty feet from a scaffold. His chief complaint on admission to the hospital was pain in the back and inability to move legs. At the time of the fall, on striking the ground, he landed on his back, he did not strike any object before hitting the ground but a heavy plank is said to have fallen across his abdomen, following him down.

He gave a history of rheumatic fever fifteen years ago. During army service in France in 1917 he was struck on the head by a wooden beam. Has been nervous and "flighty" ever since. Habitually constipated, bowels moving only once each week.

On admission he was in great pain and very badly shocked. His temperature was 97.3, pulse 66, respirations 20, blood pressure 80/20, facies is apathetic, lips cyanotic and skin cold and moist.

There was a fairly large laceration of the scalp on posterior part of skull, which had been sutured and dressed in the receiving ward—otherwise negative except for carious teeth. *Neck*—Negative. *Chest*—Is clear to palpation, percussion and auscultation. *Heart*—Apex beat in fifth interspace in mid-clavicular line. First and second sounds are heard. No murmurs and no arrhythmia present. *Abdomen*—Is scaphoid, not tender, no masses, no fluid, slight muscle guarding in both upper recti. Patient has great deal of pain in lumbar region. Tenderness over lower thoracic and lumbar spine. No deformity of spine is demonstrable.

Extremities—Patient is unable to move legs. Has absence of reflexes. Anæsthesia up to six inches below the level of Poupart's ligament, and about the rectum. No loss of sensation of skin over penis but there is loss of sensation over the scrotum.

Rectal—Bladder slightly distended. Sensation of fullness in the post-vesical region. Bladder catheterized sixteen ounces of urine—blood tinged. Six hours after admission—Patient has not reacted from shock. Temperature is still subnormal, pulse slow and respirations 20. Blood pressure is still 80/20. He complains bitterly of pain in the abdomen, which is continuous. Abdomen is flat, board-like in rigidity and shows generalized tenderness. No fluid can be detected. There is an occasional flicker of peristalsis. Heart sounds resonant throughout entire abdomen. Leucocyte count 19,100, white blood cells, polymorphonuclears 89 per cent, urine shows 200 to 300 red blood cells.

It was decided to perform an immediate exploratory laparotomy on the probability that the patient was suffering from a ruptured viscus in addition to his spinal cord shock. This was done under nitrous oxide, oxygen anæsthesia through a right rectus incision. This proved to be entirely negative, however. On the following day, patient

vomited frequently a large amount of dark brown fluid Stomach was washed out and a Jutte tube allowed to remain for drainage On following day, the second following exploratory laparotomy, he was still vomiting although his general condition was fair in spite of this fact Complete paralysis and loss of sensation of lower limbs persist Given 500 cubic centimetres of 10 per cent glucose in normal salt solution intravenously Vomiting ceased on third day after accident Again given 500 cubic centimetres of 10 per cent glucose in normal salt solution The neurologist to the hospital, Dr W B Cadwalader, gave the following report

"Man is completely paralyzed in both lower limbs for motion and all forms of sensation He has retention of urine and faeces Both limbs are flaccid The patellar and Achilles' reflexes are absent, on each side Irritation of soles of feet produces no movement of any kind He cannot recognize when toes or feet are moved by the examiner His sensation for light touch and pin prick is abolished in each lower limb as high as the line corresponding to about two inches below the anterior superior spines of the iliac bones of each side anteriorly and a corresponding point posteriorly Cremasteric reflex is absent This would indicate a lesion of the spinal cord or of its roots, the upper limits of which would not extend higher than the first lumbar root or segment This would correspond to the body of the twelfth thoracic vertebra There is marked tenderness over the ninth and tenth, eleventh and twelfth thoracic spines The X-ray examination of today shows a crush injury of the body of the twelfth thoracic vertebra corresponding to the clinical signs of the lesion in the cord The cord is probably crushed at this level Would recommend laminectomy to expose this area of the cord It is most likely that the man has had, because of this injury, hæmorrhages and destruction of the intramedullary tissues of the cord at this level For this reason, therefore, removal of compression will probably lead to partial recovery of function but not necessarily complete recovery I see no reason to do a lumbar puncture Upon examination of scrotum there is impaired sensation, a sharp pin prick feels dull There is anæsthesia about rectum Pressing the testicle gives pain The lesion is below the tenth dorsal segment of cord and above the sacral segment"

Given 1000 cubic centimetres normal salt solution by hypodermoclysis and 250 cubic centimetres intravenously April 7, 1929, laminectomy was done by Doctor Rodman, eleventh and twelfth thoracic and first lumbar vertebræ exposed Crush fracture of the twelfth thoracic vertebra found Spines and laminae of the exposed vertebra removed No direct pressure on cord found and no extradural bleeding On opening dura, cord exposed for a distance of about three inches No œdema, no hæmorrhage and no visible evidence of contusion of the cord found Wound closed in usual way with rubber dam drain to dura (interrupted silk in dura, catgut in muscles, silkworm gut in skin) Patient reacted well from the operation

Progress Notes—The general condition of the patient improved somewhat for a time and the laminectomy wound healed by first intention, the stitches being removed on the tenth day following operation, at which time there had been no improvement in the paralysis A cystitis developed three weeks after operation, it having been necessary to catheterize the patient since his injury At this time the neurologist made the following note

"Completely paralyzed for motor and sensation as before No voluntary motion in lower limbs below the hips Irritation of soles of feet produces no motion of any kind There are no automatic reflex phenomena When the lower limbs are pricked with a pin he does not feel it until the upper third of the thigh is reached anteriorly He cannot recognize movement of the toes nor movement of the feet by examiner Deep sensation as well as superficial sensation is abolished He says he can feel in his lower limbs when he is being washed but I can find no evidence of the return of cutaneous sensation His answers are misleading and he might give the impression of having sensation if the examination is not carefully made Recovery at the present time would seem

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unfavorable but it is too soon to give a definite opinion. Partial recovery might occur, but I regard it as very doubtful."

The situation remained unchanged except that the cystitis cleared up and a bed sore at the tip of the spine appeared six weeks after injury. Seven weeks after injury, Doctor Cadwalader made the following notes:

"Examination for sensation shows that it is abolished to about the same level as before, but he can occasionally recognize pin point as painful in the anæsthetic limbs. This, however, is very irregular, uncertain and not felt in a normal manner. I would conclude that although there is an apparent slight recovery of sensation, it is by no means sufficient to warrant an opinion that any satisfactory improvement will occur. His motor paralysis has not improved."

A further neurological examination made on June 6, a little over two months after the injury, showed complete paralysis of lower limbs. Vesical and rectal paralysis. Sensation—complete anæsthesia of touch (light) up to third lumbar segment, complete analgesia (pain and pin prick) up to second lumbar—hyperalgesia above. Deep pressure sense present in feet, said to have been absent before. Slight evidence of return of sensation. Fracture of twelfth lamina without dislocation and operative findings indicate hematomyelia (hæmorrhage within cord).

Save for the fact that pressure sores developed on each heel, the patient's condition remained unchanged until his transfer to the Philadelphia General Hospital on November 28, 1927, some eight months following the injury.

In a search of the available records of the cases of spinal cord injury occurring in the hospitals with which I am connected (Presbyterian, Bryn Mawr and Woman's College Hospitals of Philadelphia), only one other case was found in whom abdominal pain was present. This record is as follows:

CASE II—A man, thirty-nine years of age. On the night of December 8, 1928, patient jumped out of a second-story window in an attempt at suicide. He was brought to the Presbyterian Hospital and on admission was complaining of severe abdominal pain in the right hypochondrium. At that time he was in a condition of mild surgical shock and was admitted to Dr. E. B. Hodge's service. Because of the abdominal pain and marked rigidity a rupture of the liver was suspected. He was mentally confused and had sustained also a laceration of the scalp. In about two hours the abdominal pain and rigidity in the right hypochondrium had subsided, and the patient's color had returned to normal, but he was detained for further observation. Blood pressure 120/85. The detailed history and physical examination will not be repeated here. In the light of the subject under discussion the only relevant facts are that he is single, has been very nervous and uses alcohol to excess. There is tenderness over the lower lumbar region of the back showing on the left side an area of ecchymosis. Palpation here reveals some tenderness. There was no paralysis or altered sensation in lower extremities, although both knee-jerks were markedly diminished. No Babinski or ankle-clonus. The elbow-jerks were entirely absent bilaterally. An X-ray of the lower lumbar spine and pelvis revealed a fracture of the lateral processes of the third and fourth lumbar vertebrae as well as slight tearing of the rim of the left acetabulum. Lumbar puncture obtained clear cerebrospinal fluid under twenty millimetres hæmoglobin pressure. The blood Wassermann was negative as was the Kahn precipitation test. The neurologist's report expressed the opinion that the patient was in all probability suffering from an alcoholic psychosis with the possibility of a beginning paresis.

In a somewhat exhaustive search through the literature I have been unable to find another case in which abdominal pain and rigidity complicating spinal cord injury was so severe as to lead to an abdominal exploration. The fact that this was done in the first of the two cases now being placed on record

and that the abdominal findings were entirely negative is, so far as I am able to determine, the first absolute proof that such symptoms can occur without injury to any abdominal viscus. One finds mention of either abdominal pain, rigidity or vomiting associated with spinal cord injury in a few isolated cases similar to the second case here reported in which the experience of the first case was of great help in determining the course of watchful waiting during which these symptoms disappeared. Thus in the third case reported as one of a series of three showing spinal cord injury by Brickner and Milch,¹ abdominal rigidity and later distention was a part of the clinical picture in a case showing fractures of the eleventh dorsal and the first and second lumbar arches, as well as the left lateral process of the second lumbar vertebra. In this case laminectomy was done exposing the cord from the eleventh dorsal to the third lumbar vertebræ and a clot was removed from about the cauda equina which was found very cedematous but otherwise intact.

It has long been known that abdominal pain may be caused by extra-abdominal lesions and that, *vice versa*, abdominal lesions themselves may cause extra-abdominal pain. We are all entirely familiar with the difficulty, at times, in making a differential diagnosis between pneumonia, especially of the lower lobes, and appendicitis. Especially has this difficulty been increased in my experience in the extremes of life. Goldbloom² states that while it is well recognized that such lesions as pericarditis and pleuritic effusions may be associated with abdominal pain that this association is not nearly so well appreciated in other, even more common, extra-abdominal diseases as tonsillitis, the infectious fevers, etc. He further states that empyema caused such "dominant" abdominal symptoms in two of his cases as to lead to the diagnosis of peritonitis being seriously considered. In both of these cases, the abdominal symptoms quickly subsided after thoracotomy. The acute pain referred to the abdomen in the gastric crisis of tabes has led to negative findings by laparotomy as we know. Peck³ states that he has seen gastroenterostomy performed in such cases and refers to other extra-abdominal lesions causing severe abdominal pain as the thoracic ones mentioned above, angina pectoris and thoracic aneurysm.

Undoubtedly the most important contributions made to the understanding of traumatic lesions of the spinal cord were those made by Riddoch⁴ and Head⁵ in 1917 when they published a detailed study of cases in whom the cord had been divided at varying levels by war injuries. It is to them that we owe our present-day conception of spinal cord shock. These studies made definitely clear the fact that the spinal cord does not regenerate after injury but that many reflex acts, as partially emptying the bladder, reappearance of the patella tendon reflexes and reflex movements of the lower limbs, may be found in the stage of "mass reflex" which occurs after complete division of the spinal cord. Such a stage of "mass reflex" may last many months, indeed many years, as in the case originally reported by Stewart and Harte⁶ and studied nineteen years later by Cadwalader⁷. There is no reference in

these epoch-making articles, however, of such acute abdominal pain having been present as was observed in the first of the cases herein reported

It is quite beyond the scope of this paper to attempt a complete explanation of acute abdominal pain, due solely to spinal cord injury. This matter has engaged the attention of some of our best neurological minds recently. We know that pain and temperature fibres enter the cord *via* the posterior nerve roots and then cross the commissure to ascend to the thalamus *via* the anterolateral tracts of the opposite side. It has been believed that in the dorsal region one or two segments only are necessary for such crossing and that four to six segments in the cervical region may be so involved. The recent views of Forster, however, make it seem likely that this crossing is immediate. Head, Elsberg, Forster and others have shown that as these fibres ascend they may occupy a lamellar position. Pollock and Davis⁸ in recalling Holmes' study of unilateral lesions of the spinal cord state that from his observations it could be concluded that the fibres from the lower segments occupy a position lateral to those from the upper. They believe that in intramedullary tumors of the upper dorsal region the fibres conducting pain, heat and cold are distributed from within outward.

This matter of the association of abdominal pain with spinal cord lesions came in for a part of the discussion during the German Neurological Congress, at Vienna, in 1927. Thus Schwab⁹ states that section of the cord at the first dorsal segment abolishes all pain in the internal organs of the chest and abdominal cavity while at the sixth dorsal segment section abolishes pain in the organs of the abdominal cavity and pelvis. Forster¹⁰ is of the opinion that pain from the abdominal organs is carried largely by way of the sympathetic nervous system, especially over the peri-arterial net of the aorta and the visceral arteries. It is uncertain, he thinks, whether and to what degree the afferent fibres of the vagus and the phrenic nerves also serve as pain transmitters.

While not so prominent a feature as pain, abdominal rigidity was present to a marked degree in the first of the two cases here reported and partially, at least, led to the presumption that there had been an intra-abdominal injury. A Hoffmann¹¹ found that rigidity of the abdominal walls is usually due to a reflex action through the intercostal and lumbosacral nerves, while, therefore, it is usually produced when the parietal peritoneum is irritated it may be easily produced through direct action on the intercostal and lumbosacral nerves, as occurs for example in kidney injuries when there is inflammation in the region of the spine. Irritation of the posterior roots may also produce rigidity and thus lead to errors in diagnosis. Hoffmann states that many a case of gunshot injury to the kidney or of perinephritic abscess has been subjected to laparotomy because the abdominal rigidity suggested that one was dealing with an intra-abdominal lesion. He quotes Weil as stating that in the literature cases of crushing wounds of the vertebral column are reported in which this symptom was present to a high degree. Since, therefore, abdominal rigidity is a reflex process, it follows that it occurs in irri-

tations of the parietal peritoneum as long as the short reflex arc is intact, *i e.*, it will occur even after section of the spinal cord in the middle or upper thoracic segment. It has been known, although perhaps not generally appreciated, that disease of or changes in the abdominal walls might be responsible for abdominal pain and rigidity. We are familiar with the fact that intercostal neuralgia may closely simulate the symptoms of chronic appendicitis, J. B. Carnett¹² having stressed this fact. Two cases are reported by Poniemunski¹³ in which these symptoms were due to changes in the wall and injury to the intercostal nerve in connection with resection of the ribs.

In the first of the two cases which I am now reporting the diagnosis of traumatic hæmatomyelia has been substantiated beyond reasonable doubt. This opinion, originally expressed by the neurologist to the hospital, Doctor Cadwalader, was made more certain when I failed to find damage to the cord itself in performing a laminectomy as included in the case history. The present condition of the patient about one year after operation is substantially the same as when operated upon. He does, however, complain occasionally of a numb, burning sensation on irritation of the skin of the lower limbs. This phenomenon resembles that described by Forster and others to which the name "hyperpathia" has been given and is rather characteristic of incomplete destruction of the pain fibres in the anterolateral regions of the cord in these traumatic cases.

Since the subjective sensation of pain must depend upon the cerebral registration of afferent impulses, it follows that only in such incomplete lesions is it possible. Complete anatomical section of the cord does not cause pain because of this fact. The fact, also, that at no time has this man established a complete stage of "mass reflex" makes us feel all the more certain that the diagnosis of hæmatomyelia is correct, for Riddoch believes that it is only in complete transverse cord destruction that "mass reflex" is fully established.

I believe that the explanation of the acute abdominal pain and muscle rigidity in this case, then, is in all probability due to irritation of the posterior roots by the crush fracture of the twelfth thoracic vertebra. It seems unlikely that the autonomic nervous system played an appreciable part in the production of the pain in this case, since pain arising from this source is thought to be dull in character and not nearly so severe as in this instance. It is true that a heavy board is said to have struck him across the abdomen, following him downward in his fall. Had this pain been less severe and more immediate, we might have attached more importance to this fact but believe that nothing short of root irritation could have been responsible for such extreme agonizing pain as this man complained of. Surgical shock as well as spinal cord shock no doubt played a part in the delay of the onset of the pain. Absence of reflexes at this time in the lower extremities with complete paralysis attest the latter, as the well-known picture of surgical shock showed this to be present.

I repeat that the principal object of this paper is to stress the fact that severe abdominal pain, rigidity and vomiting may occur as the result of spinal

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cord injury alone, and need not necessarily be accompanied by any intra-abdominal lesion

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SOME UNUSUAL TYPES OF ABDOMINAL HÆMORRHAGE *

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I AM reporting four cases of abdominal hæmorrhage of unusual interest and considerable rarity, which caused a serious emergency and called for immediate operation

- 1 Intraperitoneal hæmorrhage due to a teratoma of the ovary
- 2 Intraperitoneal hæmorrhage due to spontaneous rupture of the liver
- 3 Hæmorrhage into the abdominal wall due to spontaneous rupture of the deep epigastric artery
- 4 Fatal spontaneous extraperitoneal hæmorrhage in a hæmophilic

CASE I—*Intraperitoneal hæmorrhage due to a teratoma of the ovary* Miss D, seventeen years of age, white February 1, 1926, she complained of severe crampy pains low down in the abdomen, which her mother thought were due to the onset of her menstrual period Two days later her physician was called, and attributed the pain to uterine contractions It subsided with a sedative and she was quite well until a fortnight later when she was seized with severe pain over the lower abdomen, and was sent into the Wellesley Hospital

Examination on Admission—She was decidedly masculine in appearance, with deep voice and moderate growth of hair on the face, skin pale, temperature 101° F, pulse 140, heart sounds normal, a few râles at the bases of the lungs, leucocyte count 25,600, polymorphonuclears 88 per cent, urine negative Both recti on guard, abdomen doughy to the touch, with tenderness on both sides below the umbilicus, more marked on the right than the left Liver dullness present

Vaginal examination under anæsthetic showed the clitoris to be about four times the normal size with a well-developed glans The labia were poorly developed The pubic hair had the masculine distribution The uterus was very small, and on its right side an elastic mass the size of a goose egg could be felt

On opening the abdomen about four ounces of dark red blood exuded A tumor about the size of a tangerine orange was seen lying to the right of the uterus, with a loop of small intestine adherent to it It had the appearance of a tubal gestation After separating the gut and freeing the mass from the right cornu of the uterus, the growth was found to involve the right ovary only The whole mass was removed, when the capsule of the growth was found to be ruptured, with blood and necrotic material oozing from its upper surface One thousand cubic centimetres of 5 per cent glucose was given intravenously on the table

She made good progress for about a week, when signs of internal hæmorrhage appeared, and examination revealed the left chest flat on percussion, with distant and feeble breath sounds The temperature rose to 106° F She became rapidly weaker, and died March 1, fourteen days after the operation

A complete post-mortem examination was not permitted, but the abdominal incision was enlarged Nothing of note was found in the peritoneal cavity The diaphragm was detached from the ensiform cartilage and incised vertically and laterally When the left pleural sac was opened about two quarts of fluid blood ran out The lung was represented by a hard fibrous mass the size of a grapefruit, densely adherent to the parietal pleura, the adhesions being so strong that all the lung could not be removed The right lung was smaller than normal and invaded with dark areas There was no blood in the

* Read by title

UNUSUAL TYPES OF ABDOMINAL HÆMORRHAGE

pleural cavity The heart and pericardium were normal in appearance The lungs were removed for microscopic examination She had bled to death into her left pleural cavity

The following report was given by Dr G W Loughheed, Pathologist to the Wellesley Hospital Microscopic examination shows the lung to present two distinct pictures The greater portion is extremely hemorrhagic, the alveoli being filled with red blood cells, and there is some cedema Other portions of the lung show the alveoli filled with groups of small cubical cells several layers deep, which resemble closely Langhans's cells of the chorion Covering these are large multinucleated cells which stain deeply and look like typical syncytial cells Surrounding both these embryonic cells are areas of hemorrhage

Diagnosis—"Chorion epithelioma" of the lung secondary to teratoma of the ovary Doctor Loughheed examined the tumor removed at operation, and reported as follows

Tissue received consists of an irregular ovarian tumor about two inches in diameter, together with the tube On section the cut edge of the ovarian tissue is dark red in color and very friable There are areas which appear to be necrotic The tube is attached to the ovary, and at this point there is a hard mass the size of a hazel nut This appears to be either new formed bone or a calcareous deposit

Slides made from the ovarian tissue show definite rudiments of viscera, skin, sweat glands, cartilage and ganglion cells There are also groups of atypical vesicular cells rapidly proliferating, and showing numerous atypical mitotic figures Other cells are more adult in character, and show a tendency to pearl formation

There are still other groups

of cells of the lymphoid type Interspersing these are numerous young blood vessels which have ruptured, flooding the areas with blood The capsule of the ovary proper is eroded by the vesicular cells which are multinucleated and have the appearance of being the syncytial cells of the chorion

Diagnosis—Teratoma of the ovary undergoing chorionic epitheliomatous change

Bland-Sutton defines this tumor as an irregular conglomerate mass containing the tissues and fragments of viscera belonging to a suppressed foetus attached to an otherwise normal individual He accounts for its occurrence by suggesting that the teratoma and the autosite are conjoined twins, the tumor of course being the result of incomplete development MacCallum supports the theory that they arise from isolated blastomeres, and gives



FIG 1—Low power Lung tissue

many excellent reasons for this view, but until we understand the processes of parthenogenesis and the pathogenesis of tumors in general, the origin will remain a matter of speculation

The occurrence of ovarian teratomata is fairly common, being given as from 4 to 18 per cent of all ovarian tumors but if dermoids be excluded, even the lowest of these figures, in our experience, is too high

Morphologically, the ovarian ones are composed of all tissues, though liver, pancreas, testicle and ovary are not represented. As each tumor is unique in its composition it would tend to confirm the hypothesis of origin given above as supported by MacCallum, because as he says, should they arise

from fertilized polar bodies or primary sex cells, one would expect more uniform and complete representation of tissue

As in the case of other unusual abdominal tumors, the pre-operative diagnosis is very seldom made, surgery becoming imperative in consequence of rupture or other disturbance due to the size of the growth or its metastatic involvement



FIG 2—Low power Ovarian tissue

nurse. For the last year she had suffered from indigestion and malaise, and about two months ago consulted her physician who diagnosed cholecystitis and gave her a special diet. She did not improve, and since then had only been able to do half-time duty.

On the day of admission she was suddenly seized with very severe abdominal pain on the right side of her abdomen and extending through to the back. It was of a steady stabbing nature and was soon followed by collapse. When her physician arrived he found her almost in extremis, with cold skin, small pulse and marked pallor, and after administering stimulants sent her into the Wellesley Hospital.

On admission she was suffering great pain in spite of one-half grain of morphia, from which her pupils were still tightly contracted, the skin was slightly jaundiced and the pulse was 160, small and thready.

Abdominal Examination—A board-like rigidity was present on the right side, extending into the right flank, with extreme tenderness on palpation over the whole right side. The liver dulness was markedly increased, the lower edge being a hand's-breadth below the costal region.

Urine Examination—Three plus albumen, with hyaline casts and some pus cells. Temperature 97.4°

Diagnosis—A ruptured viscus—probably gall-bladder.

Laparotomy with regional anesthesia. On opening the abdomen a large amount of

CASE II—*Intraperitoneal hæmorrhage due to spontaneous rupture of the liver.* Miss N, forty years of age, trained

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blood gushed out and there was a noticeable absence of clots. The liver appeared to occupy the whole of the right side and was purplish in color, the capsule very tense, and the interlobular markings absent. On the anterior surface, immediately below the costal margin, was a transverse laceration two and one-half inches in length, gaping widely.

As the patient was practically moribund the opening in the liver was quickly packed with gauze and the abdomen closed. One thousand cubic centimetres of 5 per cent glucose was given intravenously.

Following the operation she had a great deal of abdominal pain which could not be entirely relieved. The urine contained large amounts of tyrosine and leucine. The bowels functioned well with enemas, but she never properly rallied, and succumbed on the third day.

A partial post-mortem was obtained which showed the liver to be twice its normal size, the capsule very tense, and the substance rubbery. The spleen was normal in size, had no adhesions surrounding it, and all the other abdominal structures were normal.

On making a section of the liver one found a great many greenish-white areas mixed with purplish looking liver substance, and the microscopic appearance shown below is that of a marked diffuse hepatitis.

The slide shows atrophy of groups of the liver lobules, which are replaced by fibrous tissue, red blood cells and lymphocytes. The remaining liver lobules show marked cloudy swelling. The central and the perilobular veins are markedly congested and dilated with red blood cells. The bile capillaries show early proliferation and infiltration with lymphocytic and endothelial cells.

Diagnosis—Acute hepatitis with early atrophy.

This type of case occurs not infrequently. The surgeon is asked to operate in a case of hæmorrhage or ascites, or when the diagnosis is obscure.

The pathological changes which occur in the liver in lesions of a toxic origin, according to Mallory, do not differ essentially from changes occurring in tissues elsewhere from the same cause, and for this reason he suggests that the terms "acute yellow atrophy, cirrhosis," etc., should be abolished and the conditions indicated in the term "hepatitis."

CASE III—Hæmorrhage into the abdominal wall due to spontaneous rupture of the deep epigastric artery. Mrs M, thirty-nine years of age, two para. Now about six and



FIG. 3.—Low power. Liver.

one-half months pregnant Has always enjoyed good health After her usual day's housework was sitting at dinner when she was suddenly seized with very severe pain in the right side, and collapsed Her physician was summoned and found a rapidly increasing tumor in the right iliac region, which he thought due to a ruptured uterus, and sent her immediately into the Wellesley Hospital

On admission the tumor was about the size of a cocoanut

Pelvic examination was not very satisfactory on account of the great pain from which the patient was suffering, but she was thought to have a ruptured uterus and was immediately prepared for operation

The incision was made a little to the right of the mid-line, over the centre of the tumor When the sheath of the rectus muscle was incised blood shot out with great force as it was under terrific pressure The hæmorrhage was found to be coming from the deep epigastric artery which had stripped up the muscle from its posterior sheath over a large area This stripping process had been carried out into the flank, forming a large hæmatoma The artery was ligated, the blood clot removed, and the cavity lightly packed with gauze It was not necessary to open the peritoneum

She made an uninterrupted recovery and gave birth to a living child at the end of ten days

This condition is apparently very rare, as none of our obstetricians in Toronto had seen a similar case

CASE IV—*Fatal spontaneous extraperitoneal hæmorrhage in a hæmophilic* Mr R, forty-six years of age He was suddenly taken with pain in the left lower quadrant of the abdomen, and the following day a mass appeared which could be felt upon rectal examination With a sigmoidoscope, ecchymosis of the rectal wall was seen about three inches up the rectum

I saw him for the first time three days later, when he was on the operating table His pulse was rapid, and a swelling could be seen occupying the left iliac, hypogastric and umbilical region, which was dull on percussion

The abdomen was opened in the mid-line and nothing found within the peritoneal cavity, but a large collection of blood clot was outside the peritoneum, where fresh oozing of blood was going on We thought it might be due to a sarcoma, but owing to its being so widespread nothing could be done beyond packing the cavity with gauze Transfusions were given, with no benefit, and he died three days later

Post-mortem examination revealed a large collection of clotted blood separating the peritoneum from the parietal wall in front as high as the umbilicus, and extending backward and upward until the diaphragm was reached No evidence of a growth was found

After the operation we got a history of his having been hit with a stone on his left eyebrow three years previously when great difficulty was experienced in stopping the bleeding He was evidently a hæmophilic

GLUCOSE TOLERANCE AND HEPATIC DAMAGE

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AND

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MANY methods have been suggested for determining the functional capacity of the liver. The liver has many functions, consequently it is unlikely that any one test will measure accurately its total physiological capacity. Since Claude Bernard discovered the important part played by the liver in carbohydrate metabolism through the storage of glycogen, many attempts have been made to determine liver function by the observation of variations in body reactions to different sugars. Most of these tests have been discarded because of unreliability or lack of specificity. We believe it probable that information of clinical value concerning the glycogenetic function of the liver can be obtained by a new interpretation of the usual glucose tolerance test.

Strauss¹ in 1901 proposed levulose as a test for hepatic function, studying its appearance in the urine after the ingestion of 100 grams by mouth, but later observers summarized by Rountree, Hurwitz, and Bloomfield² discard it as of no clinical value. With the development of methods for the determination of blood sugar there has been a renewed interest in the levulose test, well summarized by Greene *et al.*³ Spence and Brett⁴ report definite changes in blood sugar curves following the ingestion of levulose by patients with hepatic disorders. Bodansky⁵ studied the tolerance of normal dogs for glucose, levulose and galactose. He found that levulose is less effective and galactose more effective than glucose in producing alimentary hyperglycemia. He⁶ then studied carbohydrate tolerance in experimental liver derangements due to chloroform and phosphorus poisoning, finding the levulose tolerance tests valuable in measuring liver involvement in these conditions. Lowered tolerance for glucose and galactose was likewise associated with severe liver injury, but he states that glucose cannot be used as a function test because other factors may influence the tolerance for this carbohydrate. The occurrence of hypoglycemia following hepatic poisons has been shown by Frank and Isaac,⁷ using phosphorus in rabbits, Williamson and Mann⁸ in dogs following the administration of chloroform and phosphorus. Izume and Lewis⁹ found hypoglycemia in rabbits after administration of hydrazin and state that this is due to a failure of normal glycogenesis as a result of which the supply of glucose available is diminished because of injury to the liver. Mann¹⁰ in his extensive studies of physiology following total removal of the liver showed a constant decrease in blood sugar levels and a close correlation between this level and the clinical condition of the animal. Mann and Bollman¹¹ studying partially hepatectomized animals found the blood sugar levels decreased, but regardless of the amount removed an adequate level was always maintained and the rate of recovery of the blood sugar level was prolonged after the removal of a considerable portion of the liver. The study of function following partial hepatectomy is difficult because of the great regenerative power and the excess capacity of the liver. Fishback¹² has shown that regeneration occurring as hypertrophy of the remaining lobes will be complete in from six to eight weeks with an actual restoration of four-fifths of normal weight and volume.

After we had observed distinct variations from the normal glucose tolerance curves in patients with known liver damage we studied the behavior of this standard test in animals whose livers had been injured by partial removal or by hepatic poisons. Normal dogs were given glucose tolerance tests, after which portions of the liver were removed at intervals, and the glucose tolerance again studied. In determining the glucose tolerance the following method was used. The dogs were fasted for twenty hours before the beginning of the test. The fasting blood specimen was withdrawn from a vein. There was 1.75 grams of glucose per kilogram of body weight given in 100 cubic centimetres of water by stomach tube. At intervals of

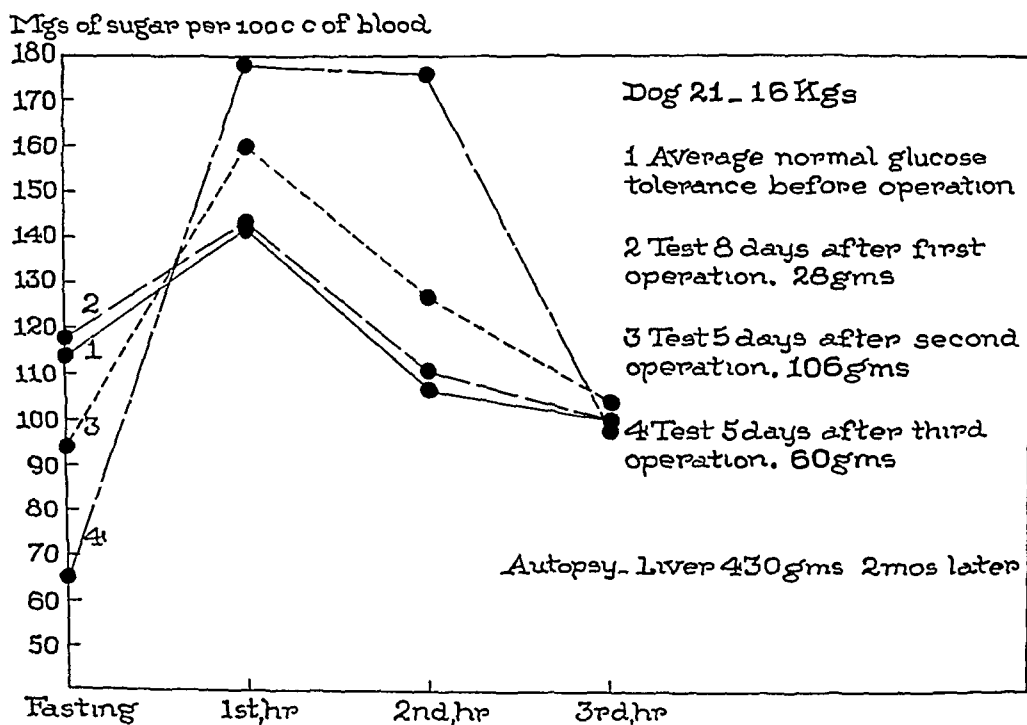


FIG 1—Graphic representation of Table I, showing alterations in shape of curve with each increment of liver removed

one, two, and three hours blood specimens were withdrawn using sodium citrate as an anticoagulant. The blood filtrates were made immediately after the blood was withdrawn and kept in an ice box until the completion of the test. The blood sugar was then determined by the Folin-Wu method. All operations were done through a median incision under complete ether anesthesia. The lobe lightly held in clamps was resected beyond them and the stump ligated in continuity. Blood sugar determinations were not made till at least three days after operation to allow the possible variations associated with the operation to disappear. Every endeavor was made to maintain nutrition at a normal level. The results of these studies in four dogs are shown in Tables I to IV.

When glucose in this amount is taken into the alimentary tract of a normal fasting individual there is found at the end of one hour from 15 to

GLUCOSE TOLERANCE AND HEPATIC DAMAGE

17 per cent blood sugar At the end of two hours this amount has dropped to about 12 per cent and at the end of the third hour the amount has

TABLE I
Glucose Tolerance Tests with Three Operations on Liver

Dog No 21

Date	Weight in kilograms	Milligrams sugar per 100 cubic centimetres			
		Fasting	1 hour	2 hours	3 hours
November 18, 1927	16.5	111	138	105	93
November 22, 1927	16.5	117	146	109	116
November 29, 1927	Operation—28 grams of liver excised				
December 7, 1927	16	118	143	111	100
December 21, 1927	16.1	108	140	97	105
December 28, 1927	Operation—106 grams of liver excised				
December 31, 1927	15.7	94	160	127	104
January 4, 1928	15.5	107	158	112	104
January 11, 1928	15.5	76	129	98	74
January 21, 1928	15.4	79	120	85	77
February 29, 1928	14.5	64	103	91	68
March 3, 1928	Operation—61 grams of liver excised				
March 8, 1928	14.2	65	178	176	98
March 10, 1928	14	63	167	151	89
March 15, 1928	14.4	60	123	79	63
March 21, 1928	15	56	110	65	65
April 17, 1928	14.5	57	103	60	61
May 21, 1928	14	65	105	68	63
May 23, 1928	Operation—65 grams of liver excised				
May 24, 1928	Animal died Liver weight 430 grams				

returned to approximately the fasting level When injury to the pancreas exists the fasting blood is abnormally high and following the ingestion of

COLLER AND TROOST

glucose remains high in the second and third hours instead of showing the normal decline This has been called the diabetic type of curve In the absence of injury to the carbohydrate mechanism one occasionally obtains a type of curve in which the fasting level is normal but which reaches an abnormal height at the end of the first hour but which has been restored to normal levels at the end of the second hour (Emotional hypoglycemia)

TABLE II
Glucose Tolerance Tests with Two Operations on Liver

Dog No 1

Date	Weight in kilograms	Milligrams per 100 cubic centimetres			
		Fasting	1 hour	2 hours	3 hours
August 6	9 3	109	158	109	133
August 10	9 3	111	160	095	100
August 11	9 3	08	150	108	100
August 12	Operation—left lobectomy—75 grams liver excised				
August 21	8 4	125	215	220	084
August 23	8 3	107	178	176	120
August 27	8 2	116	222	137	084
September 1	8	105	181	105	100
September 2	Operation—left lobectomy—66 grams liver excised				
September 8	7 6	09	230	238	086
September 20	7 4	105	215	230	094
December 1	9 0	070	160	106	086
December 3	Died during operation—Liver weight 210 grams				

In Table I it may be noted that following the removal of twenty-five grams of liver the glucose tolerance remains unchanged Following the second operation with the removal of 106 grams of liver there is a slight drop in the fasting level The slight derangement of the curve noted during the first week after operation begins to be compensated for and in two weeks the curve is of a normal shape except for the low fasting level Following the third operation with the removal of sixty-one grams of liver there was no further decrease in the fasting level which, however, remained persistently low Determinations made five and ten days after the third operation show a marked prolongation of the curve since the level at the second hour is at about the same height as it was at the first hour As regeneration occurs the

GLUCOSE TOLERANCE AND HEPATIC DAMAGE

TABLE III

Glucose Tolerance Tests with Two Operations on Liver

Dog No 40

Date	Weight in kilograms	Milligrams per 100 cubic centimetres			
		Fasting	1 hour	2 hours	3 hours
December 30, 1928	7 5	106	123	98	106
January 4, 1928	7 5	110	132	105	107
January 7, 1928	Operation—73 grams of liver removed				
January 10, 1928	7 2	104	164	168	127
January 13, 1928	7 3	90	141	130	88
	Tests were discontinued after this date as the abdominal incision had opened Tests were started again when the wound had healed				
March 21, 1928	7 5	84	110	80	81
April 26, 1928	7 5	81	105	85	83
April 28, 1928	Operation—animal died during the operation Autopsy—liver weight 223 grams				

TABLE IV

Glucose Tolerance Tests with One Operation on Liver

Dog No 22

Date	Weight in kilograms	Milligrams per 100 cubic centimetres			
		Fasting	1 hour	2 hours	3 hours
November 18, 1927	12	97	142	102	104
November 22, 1927	12	100	138	91	103
December 2, 1927	Operation—67 grams of liver excised				
December 7, 1927	11 8	106	160	155	125
December 20, 1927	11 5	88	143	125	79
January 7, 1928	Operation—81 grams of liver excised				
Januray 10, 1928	11	94	166	163	130
January 11, 1928	Animal died of hæmorrhage Liver weight 232 grams				

level of the second hour is reduced until it arrives at a normal point. This is noticeable to lesser degree following the second operation. These changes are shown graphically in Figure 1. In Table II there are found alterations in the shape of the curve following the first operation similar to those seen in Table I. One week following the first operation the level at the second hour is slightly higher than that of the first hour. During the following five weeks it was restored to a normal level. Following the second operation the level of the second hour is again raised and is somewhat slower in its return to a normal level. Table III shows the prolongation of the curve following operation with an eventual restoration to normal at the second

Mgs of sugar per 100 c c of blood

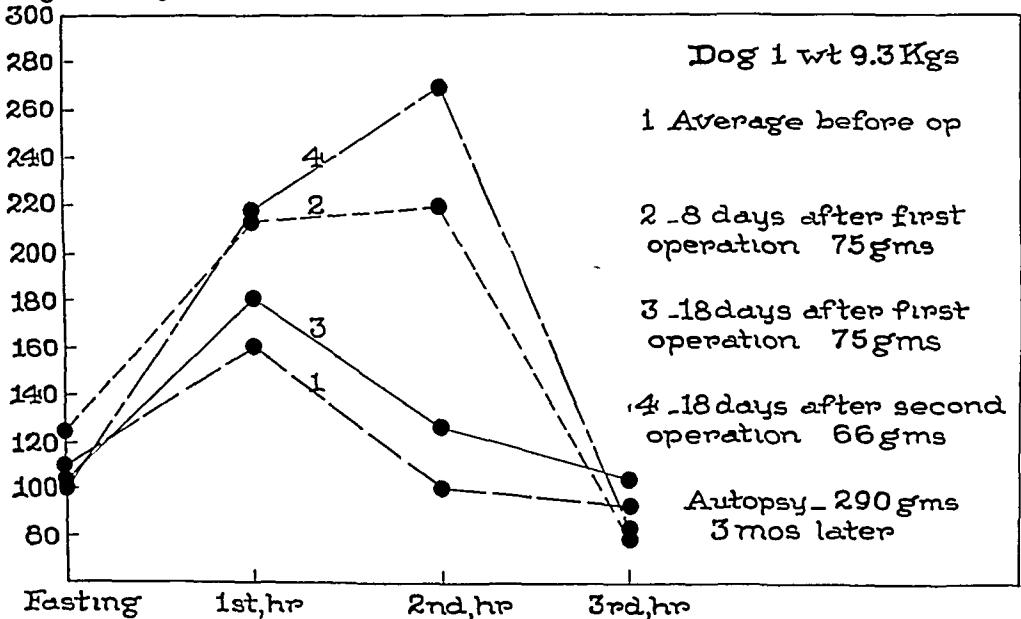


FIG. 2.—Graphic representation of Table II, showing plateau top of curve following each operation

hour. A slight lowering of the fasting level occurs. Table IV shows a similar type of curve with a high second hour level following both operations. No marked change in fasting level occurred but the experiment was a short one. The prolongation of the curve after each operation is marked.

Much experimental work has been done in studying carbohydrate metabolism following the administration of hepatic poisons. The method is open to criticism in that other organs may also suffer damage. In order to compare the results of this method of producing liver injury with the method already used and also to study the reaction of liver thus injured to the standard glucose tolerance test with the same time elements, dogs were given chloroform in oil subcutaneously. The results in two dogs are seen in Table V. Dog No. 52 shows a marked fasting hypoglycemia with marked prolongation of the curve as shown by the high sugar levels in the second and third hours. In Dog No. 53 a marked hypoglycemia is also observed. The flat curve suggests failure to absorb glucose in this animal. A com-

GLUCOSE TOLERANCE AND HEPATIC DAMAGE

parison of the amount of damage done to the liver of each dog is impossible so that no conclusions can be drawn Bodansky⁶ found the reaction in

TABLE V
Glucose Tolerance Tests with Chloroform Poisoning

Dog No 52

Date	Weight in kilograms	Milligrams per 100 cubic centimetres			
		Fasting	1 hour	2 hour	3 hour
January 18, 1928	18	104	127	98	101
January 19, 1928	18	101	125	105	99
January 21, 1928	12 cubic centimetres of chloroform in 12 cubic centimetres of oil injected subcutaneously				
January 23, 1928	18 2	64	104	97	86
January 25, 1928	18 3	66	137	164	130
January 27, 1928	18 3	69	153	168	141
January 28, 1928	Animal was killed this date				

Dog No 53

Date	Weight in kilograms	Milligrams per 100 cubic centimetres			
		Fasting	1 hour	2 hour	3 hour
January 18, 1928	14 5	102	120	98	105
January 19, 1928	14 4	106	128	100	98
January 21, 1928	10 cubic centimetres of chloroform in 10 cubic centimetres of oil injected subcutaneously				
January 23, 1928	14 4	66	85	83	85
January 25, 1928	14 2	70	108	71	72
January 27, 1928	14 2	73	105	81	70
February 2, 1928	Animal was killed this date				

Liver (Pathologist's Report Dr Warthin) 'Active interlobar hepatitis, type of atrophic cirrhosis Slight fatty infiltration, but well-marked fatty degenerative infiltration of central portions of lobules'

chloroform and phosphorus poisoning to give results similar to those obtained in Dog No 52 Three other dogs treated in a similar manner reacted with curves as did Dog No 52

Comment—No definite conclusions can be drawn from experiments so short and incomplete, but the results are suggestive. Other factors producing alterations in rate of sugar absorption such as prolonged fasting and damage to the pancreas or pituitary gland were not present in the animals on whom operation was done. The relatively small amount of liver removed and the quick regeneration made possible only slight and transient variations in glucose tolerance, but when the effect was cumulative as in Tables I and II, the blood sugar curves assumed with each increment of damage an accentuation of certain features that may be characteristic. The fall in the

Mgs of sugar per 100 c c of blood

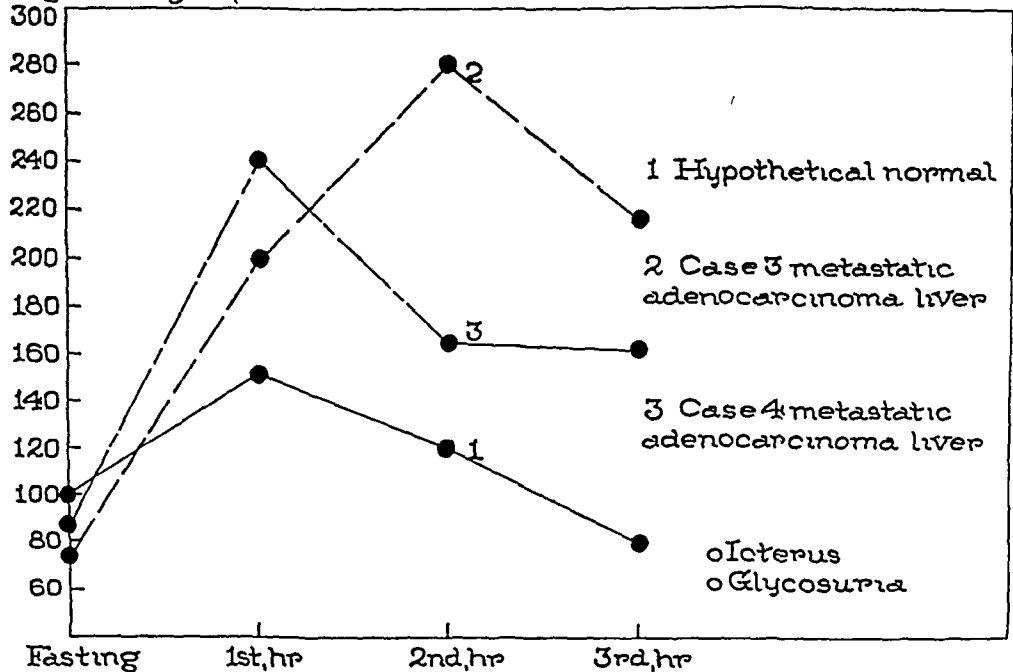


FIG 3—Graphic representation of cases 3 and 4. Marked retardation in second and third hour with low fasting blood sugar

fasting level with increased damage seems fairly constant. The high reading in the second hour and in the third hour when more liver was removed occurred regularly. It is suggested that this disturbance is due to a lessened ability of the liver to form glycogen, so that it has less to convert into glucose during fasting periods when the animal is deprived of an exogenous supply and less capacity for removing glucose from the portal blood following the ingestion of glucose. While the curves obtained with glucose are more labile than those obtained with levulose, the variations from a known normal are distinct and easily seen. The relation of the fasting level to the level at the first hour when considered alone seems to have no significance as there is often a marked variation in the height of the first hour level in normal animals and in man. This relation has been suggested as a criterion of liver damage, but varies too much to be significant.

GLUCOSE TOLERANCE AND HEPATIC DAMAGE

TABLE VI
Glucose Tolerance Tests on Patients with Intrinsic Hepatic Lesions

Glucose Tolerance Tests on Patients with Intrinsic Hepatic Lesions												
Case No	Age	Clinical diagnosis	Icterus	Blood sugar determinations						Glycosuria during test	Remarks	
				Fasting	1°	2°	3°					
1	19	Subacute yellow atrophy Arsen- ical hepatitis	No	60	140	142	156	None		Ascites		
2	16	Same Two weeks later Syphilis Luetic hepatitis	No	65	172	167	133	None		Ascites Recovery		
3	32	Ca of stomach Metastases in liver	Mlod	90	189	186	145	None		Recovery Test nine days after entrance		
4	51	Ca of stomach Massive metas- tases in liver	No	88	198	281	216	None		Autopsy		
5	34	Metastatic ca of liver	No	74	240	164	162	None		Biopsy Test seven days post-operative		
6	66	Ca of liver	No	93	186	174	159	None		Operation		
7	68	Hepatic cirrhosis	No	83	160	161	137	None		No autopsy		
8	50	Hepatic cirrhosis	No	90	161	215	198	None		Died of pneumonia one month later Ascites		
9	58	Hepatic cirrhosis	No	76	154	152	102	None		Operation Ascites		
10	55	Hepatic cirrhosis	No	90	175	178	180	None		Autopsy		
			No	90	220	290	260	Sit 2°		Autopsy		

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Clinical Observations—These studies were made on a series of patients with known disease involving the liver. The tests were conducted according to the standard methods. In Table VI are collected cases with known liver damage but without jaundice except one instance.

CASE I—A girl, 19 years of age, had acute arsenical hepatitis with jaundice four weeks before entrance to the hospital. The jaundice cleared up but ascites appeared which was present during the time the tests were made. The first curve shows a low fasting level, the levels at the first and second hours are equal and the third hour is at a level higher than either of the first two hours showing a marked prolongation of the curve. A curve taken two weeks later shows a low fasting level, with first and second hours about equal, but a distinct drop in the level of the third hour.

CASE II—A girl, sixteen years of age, with maculo-papular secondary syphilitic eruption, and a moderate jaundice thought to be due to secondary syphilitic involvement.

Mgs of sugar per 100 c c of blood

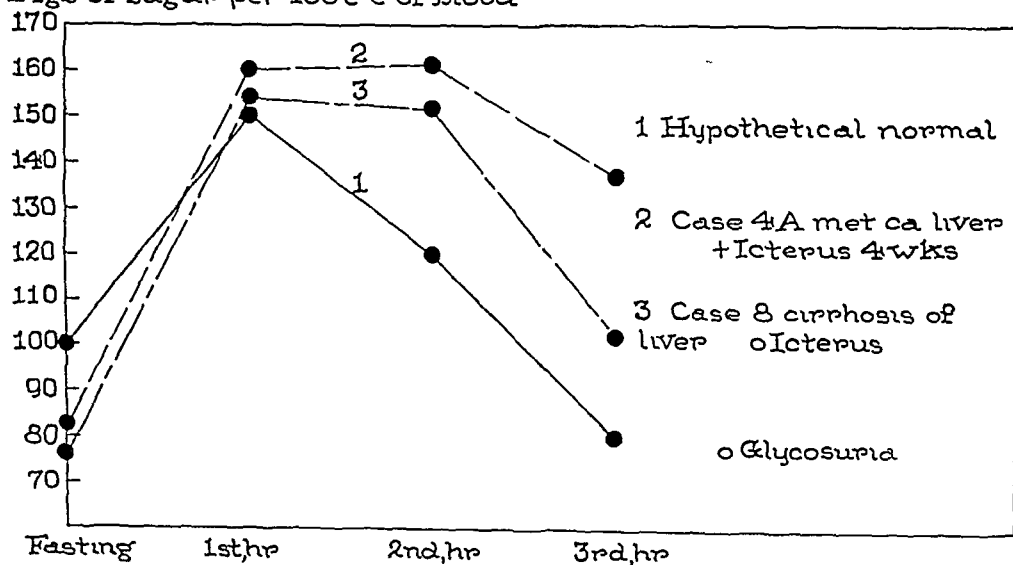


FIG 4—Graphic representation of cases 4a and 8. Marked retardation in second and third hours.

of the liver. The curve shows levels at first and second hours to be the same, giving a plateau top to the curve with a high third hour level.

CASES III to VI are patients with massive metastatic cancer of the liver. The fasting levels are lower than normal. All show a high second and third hour level in comparison with the level of the first hour. Case III in particular shows a curve that might be called diabetic in type were it not for the low fasting level.

CASES VII to X are examples of hepatic cirrhosis, of the portal type, in an advanced stage. The fasting levels are again slightly below normal and in Case VIII distinctly lower than normal. The level of the second hour is either equal to that of the first hour or higher, and three of them show a marked elevation at the third hour. All cases in this group had gross damage to the liver and all showed certain characteristic changes in the blood sugar curves.

In Table VII are grouped a variety of conditions causing jaundice. Cases 11 and 21 had acute catarrhal jaundice and both show sugar curves that are normal in every respect. This was to be expected since this condition is of short duration and no severe involvement of the liver is caused. Case 31, a woman, forty-seven years of age, with moderate jaundice and pain over the liver two months after a course of five injections of arsphen-

GLUCOSE TOLERANCE AND HEPATIC DAMAGE

TABLE VII
Glucose Tolerance Tests on Patients with Lesions Causing Jaundice

Glucose Tolerance Tests on Patients with Lesions Causing Jaundice												
Case No	Age	Clinical diagnosis	Icterus	Blood sugar determinations						Glycosuria during test	Remarks	
				Fasting	1°	2°	3°					
1a	21	Acute catarrhal jaundice	Marked 2 weeks	107	156	120	97	None		Recovery in two weeks		
2a	24	Acute catarrhal jaundice	Marked 3 weeks	110	158	118	96	None		Recovery in three weeks		
3a	47	Active arsenical hepatitis	Mod 3 weeks	57	208	91	53	Trace		Recovery in seven weeks		
		Same—in two weeks	Marked	100	256	87	63	Slight trace				
4a	39	Luetic hepatitis	Yes—6 wcks	68	85	78	65	Slight trace				
5a	50	Stone common duct	Intermittent 6 months	88	241	189	79	None				
		Same		85	153	117	80	Slight trace				
6a	49	Cholecholelithiasis		80	156	110	95	None		Before operation		
		Same	Intermittent 3 months	81	159	92	83	None		One week after choledochostomy		
7a	59	Cholecystitis	No	60	185	187	187	Yes		Two weeks after choledochostomy		
8a	75	Ca common duct Metastases in liver	Intermittent 2 months	85	164	148	140	None		Three weeks after choledochostomy		
9a	65	Ca head of pancreas	Marked 4 months	96	156	110	94	None		Operation cholecystectomy—choledochostomy		
10a	65	Same	Marked 2 months	76	101	114	138	None		Three weeks after operation Wound healed		
		Ca head of pancreas	No	66	145	240	65	None		Operation		
11a	61	Same	Marked 2 months	81	211	117	114	None		Died two weeks Autopsy		
		Ca head of pancreas	No	79	120	128	78	None		Before operation		
12a	54	Same	Marked 6 wcks	89	161	130	93	None		Two weeks after cholecystoduodenostomy		
13a	58	Ca head of pancreas	No	101	210	215	226	None		Before operation		
		Ca gall-bladder Metastases in liver	Yes—3 months	110	160	128	90	None		Ten weeks after cholecystogastrostomy		
14a	34	Metastatic ca of liver	Yes—2 months	75	135	111	71	None		Before operation		
			Marked 4 weeks	90	215	220	158	None		One month after cholecystogastrostomy Autopsy		
				83	160	161	137	None		Operation		
										Autopsy		

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mine. She lost all symptoms in seven weeks and was regarded as a mild case of arsenical hepatitis. The first curve is not grossly abnormal except for the very low fasting level, the curve being of the emotional type. A second test taken two weeks later after some clinical improvement was similar to the first except for a rise in the fasting level to normal. Case 4a was a patient with primary syphilis who developed jaundice following four injections of arsphenamine. His curve shows a low fasting sugar and a very low level for the entire curve. Several observations made during his convalescence showed a gradual rise in the entire curve to a low normal level.

Cases 5a to 7a were patients with jaundice due to a stone associated with mild infection in whom it was difficult to evaluate the amount of liver damage present. Case 5a had intermittent jaundice for six months and the curve before drainage of the common bile duct shows a low fasting level with definite elevation at the second hour. Following operation the curves gradually assume a normal contour except for persistence of the low fasting level. Case 6a with jaundice of only three months duration shows the

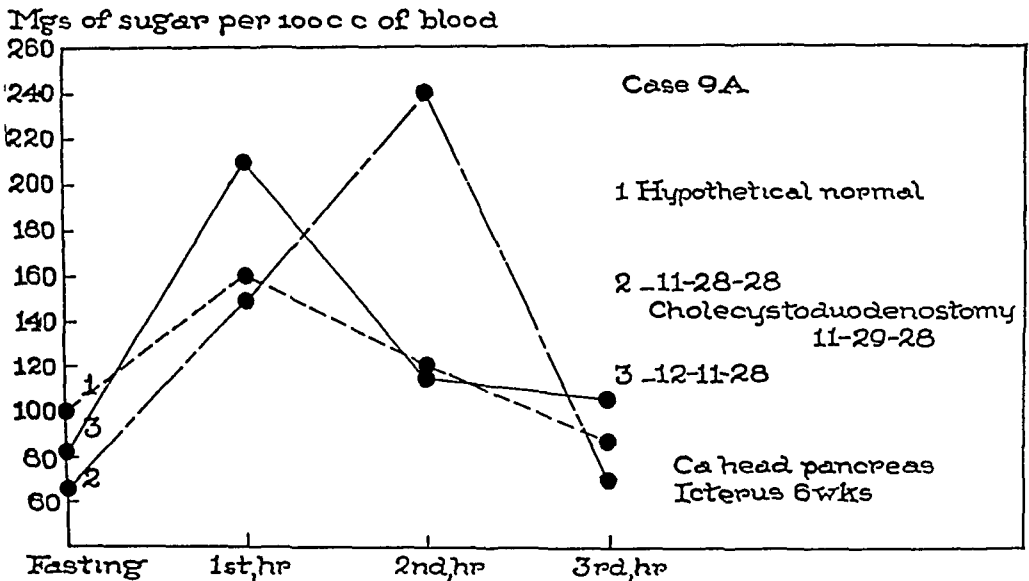


FIG 5—Graphic representation of Case 9a. Shows tendency of curve to assume normal shape after drainage of biliary tract.

same characteristics to a more marked degree. The fasting level is very low and the second and third hour levels are as high as the first. Three weeks after operation the curve is assuming a normal character except for the slight prolongation at the second and third hour. Case 7a, less severely sick, has a normal curve. Case 8a, a far advanced carcinoma of the common duct with massive liver metastases and jaundice of four months' duration, shows a very low fasting level with a progressive rise in the curve with each hour. Cases 13a and 14a are similar and show a slightly lowered fasting sugar with high second and third hour level. Cases 9a to 12a are patients with complete obstructive jaundice due to carcinoma of the head of the pancreas. Three of them show a very low fasting sugar. The curve of Case 12a is otherwise normal. Cases 9a, 10a, and 11a show levels at the second hour that are as high or higher than the level of the first hour. It might be said that these abnormalities were due to involvement of the pancreas by the carcinoma but in each of these patients internal drainage was done with a subsequent restoration of the curves to normal.

These observations on patients with jaundice do not give the same regularity of response in characteristic alterations of the glucose tolerance curves

GLUCOSE TOLERANCE AND HEPATIC DAMAGE

as did the patients with gross demonstrable damage of the liver. Obstructive jaundice alone may cause these changes or it may not. We have not found any measurable difference in reaction with relation to duration of jaundice and there must be great individual variations in other factors producing liver damage, such as infection, obstruction, and the length of time these factors have been at work. The three cases of obstructive jaundice that showed abnormal curves which returned to normal following relief of obstruction, seem to indicate a lowering of the glycogenetic function of the liver by jaundice of the obstructive sort.

SUMMARY

We believe that injury to the liver shows a disturbance of carbohydrate metabolism in two forms. First, the glucose tolerance curve tends to the diabetic type, second, the fasting blood sugar is low and this second feature thus makes it possible to distinguish the disturbance of carbohydrate metabolism from that due to diabetes. In the presence of glycosuria a low blood fasting sugar level indicates that the patient is not suffering from diabetes and strongly suggests an abnormal liver.

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MEMOIRS

THOMAS W HUNTINGTON, M D

1849-1929

IN THE passing of Doctor Huntington (April 19, 1929), California has lost another of her commanding figures—surgeon and citizen. He is the last of that group of remarkable men who, in this community at least, lived through the transition from septic to aseptic surgery.

Born in Rockford, Illinois, January 16, 1849, he received his bachelor's degree in the University of Vermont in 1871, his medical degree from Harvard in 1876. Not long thereafter he came West, became the surgeon of the Central Pacific in Wells, Nevada, and later, from 1885 to 1899, was the Chief Surgeon of the Central Pacific, and afterward of the Southern Pacific Hospital in Sacramento.

During this period he did much of his best work and some of us, as medical students, remember hearing of a surgeon in Sacramento, who removed an inflamed appendix on the diagnosis of appendicitis. This was the first operation for appendicitis done in California. It was about 1890, at a time when in our medical curriculum the word appendicitis was not once heard.

In 1899, Doctor Huntington was made Professor of Clinical Surgery in the University of California, and moved to San Francisco, where he resided ever since. He occupied the Chair of Surgery until the reorganization of the medical faculty of the University of California in 1912. In 1910, he became Chief Surgeon of the Western Pacific Railroad, which position he held until his death.

Doctor Huntington, during his middle life, carried on an extensive practice in operative surgery, bold, but not rash, a surgeon of excellent judgment, who perhaps more than any other in this community, in his generation, kept up with the advances in surgical science and art. His experience in the treatment of fractures and of tumors was especially great. His contributions to surgical literature consisted chiefly of numerous reports of clinical cases characterized by careful observation and conscientious effort—in short, sound surgery. A fluent and impressive speaker, he was often called upon for formal addresses. In later life many honors came to him. In 1913, the degree of Doctor of Laws, from his University of Vermont, in 1917, he was sent as a member of an important commission under the Red Cross to Italy, he was a Lieutenant of the Medical Reserve Corps of the United States Army, and during the World War, organized a local faculty under authority of the Surgeon-General for the instruction of reserve medical officers. He was elected Fellow of the American Surgical Association in 1901. He was president in 1917.

His wife was Miss Harriet O. Pearson, of Wells, Nevada, who, with a son and daughter, survives him. The son, Thomas W. Huntington, Jr., is

living in Capri, Italy, engaged in literary pursuits, and the daughter, Miss Emily H. Huntington, is instructor in Economics in the University of California.

At the age of eighty, Doctor Huntington was in full mental and unusual physical vigor—tall, slender, dignified, he promised to enjoy many more years of useful activity. His death, following a serious surgical operation, came as a shock to his many personal and professional friends.

EMMET RIXFORD

DR CLARENCE LESLIE STARR

1868-1928

THE death of DR CLARENCE LESLIE STARR came with startling suddenness. A few of his intimate friends knew of his serious illness, but no one thought the end was near. In fact, his medical attendants hoped that after a

few months' rest he might be able to resume work. Forty-eight hours before his death, symptoms suddenly appeared which indicated that a fatal issue was inevitable and he succumbed to the final attack of angina on the evening of Christmas Day.

Doctor Starr was born at Georgetown, Ontario, on July 1, 1868. He was a distinguished graduate in medicine of the University of Toronto and a member of the teaching staff for thirty years. In 1921 he became the first full-time Professor of Surgery, and, at the same time was appointed Surgeon-in-Chief to the Toronto General Hospital. Previously he had been Chief Surgeon in the Hospital for Sick Children. On his assuming the duties of the Chair, he completely reorganized the



DR CLARENCE LESLIE STARR

Department of Surgery. The department under his direction was recognized not only within the University as thoroughly efficient but many distinguished visitors from various parts of the world were so impressed that they expressed their admiration of his achievement in no unstinted fashion. In 1926 he was invited to Harvard University where he temporarily occupied the Chair of Surgery, and, within the last few weeks, he was asked to occupy a

similar position in St Bartholomew's Hospital, London. He had hoped to spend a few weeks there in that capacity during the summer of 1929.

During the war he rendered most valuable service both overseas and at home. With the rank of Lieutenant-Colonel he was Surgeon-in-Chief in a Special Hospital at Ramsgate, England, and later exhibited splendid organizing ability in connection with similar work at the Christie Street Hospital, Toronto.

He was a Fellow of the American Surgical Association and Vice-President of that body at the time of his death. He was also a Past-President of the American Orthopædic Association and an Associate Member of the British Orthopædic Association. McMaster University conferred on him the degree of LL.D. *honoris causa*.

He was a most popular colleague, beloved and respected by all his associates. Surviving him are his wife and four daughters. One brother, also a member of the medical profession, lives in Coaling, N. Y., and a sister lives in Brooklyn, Ont.

A PRIMROSE .

RICHARD WALKER BOLLING, M D

1882-1929

DR RICHARD WALKER BOLLING was born in Huntsville, Alabama, September 14, 1882, and died in New York, April 6, 1929, of septic pneumonia, after an illness of five days

He was of English Colonial stock, a member of a distinguished family



RICHARD WALKER BOLLING, M D

In the Virginia Historical Society there is a complete collection of family portraits loaned by Mr Richard Bolling, of Richmond, representing every generation of Bollings from Robert, the first to come to America Bolling Hall, Bolling Island, and Bollingbrook are among the historic Virginia homes

Doctor Bolling's early education was received at day school in Huntsville, and at Mr Abbott's School, near Charlottesville, Va From 1900 to 1905 he was at the University of Virginia, combining Academic and Medical courses, and graduated from the Department of Medicine

He served as interne in the New York Hospital, St Mary's Hospital for Children, and the Lying-In Hospital

During the war he enlisted with the New York Hospital Unit in May, 1917, and served with the French at Chateau Anel with Mobile Hospital No 2, and later at the New York Hospital Base at Chateauroux He was demobilized March 30, 1919, with the rank of major

He was appointed Associate Attending Surgeon to St Luke's Hospital, in New York, in 1924, and Attending Surgeon in 1927 He was also Attending Surgeon to the Babies Hospital and Consulting Surgeon to Stamford

MEMOIRS

Hospital, Flushing Hospital, New Rochelle Hospital, New York Nursery and Child's Hospital, and St Vincent's Nursery and Babies Hospital of Montclair, N J

During the last six years he published a number of interesting papers surgical diseases of children, a book on "The Surgery of Childhood," and a monograph in Lewis's *Surgery* on "Congenital Hypertrophic Pyloric Stenosis "

During the years in which he was doing active surgical work he distinguished himself in an outstanding manner by soundness of judgment and by an admirable sureness of technic His straightforward character and a certain inborn integrity inspired confidence in all those he cared for and won the admiration, respect and affection of those intimately associated with him His death, in the full swing of his personal activities, leaves behind a feeling not only of deep sorrow but of irreparable loss

WAITON MARTIN

SIR ANTHONY BOWLBY, HONORARY FELLOW

SIR ANTHONY ALFRED BOWLBY, seventy-three years of age, surgeon-in-ordinary to King George, died at his home in London, April 9, 1929, from pneumonia

Anthony Alfred Bowlby was born May 10, 1855, the son of T W Bowlby and Maria Bridget Mostyn. He was educated at Durham School and St Bartholomew's Hospital, to which he was consulting surgeon at the time of his death.

Bowlby was created a knight in 1911 and a baronet in 1923. He was president of the Royal College of Surgeons from 1920 to 1923. He was the author of many works on surgical subjects.

During the World War he held the rank of major-general.

Sir Anthony was consulting surgeon in the British forces in France during the World War and was the physician who rendered first aid to King George when his horse threw him in 1915.

EDITORIAL ADDRESS

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HELD APRIL 22, 1929

PRESIDENTIAL ADDRESS

By ASTLEY P C ASHHURST, M D

On the evening of Monday, April 21, 1879, at the invitation of Dr Samuel D Gross, there met at his residence, southeast corner 11th and Walnut Streets, Philadelphia, the following surgeons, who may be regarded, with him, as the

FOUNDERS OF THE PHILADELPHIA ACADEMY OF SURGERY

SAMUEL D GROSS, M D, LL D, D C L, Oxon, D HAYES AGNEW, M D, LL D, RICHARD J LEVIS, M D, ADDINELL HEWSON, M D, THOMAS G MORTON, M D, WILLIAM H PANCOAST, M D, JOHN H PACKARD, M D, JOHN H BRINTON, M D, J EWING MEARS, M D, SAMUEL W GROSS, M D. Dr Addinell Hewson acted as Temporary Chairman, and Doctor Meais as Secretary

Subsequent informal meetings were held in April, May, June, October, November and December, 1879, at which other surgeons were present, and in the autumn of the year application was made for a Charter, by the following

CHARTER MEMBERS OF THE PHILADELPHIA ACADEMY OF SURGERY

Samuel D Gross, D Hayes Agnew, Addinell Hewson, John H Brinton, J Ewing Meais, Thos G Morton, Samuel W Gross, Oscar H Allis, John H Packard, Richard J Levis, Charles T Hunter, Wm H Pancoast, H Lenox Hodge, John Ashhurst, Jr, De Forest Willard, Samuel Ashhurst, John B Roberts, William W Keen, William Hunt

A Constitution and By-Laws having been adopted, and the Charter granted, under date of December 27, 1879, the Philadelphia Academy of Surgery commenced its honorable career

Doctor Gross, the founder, announced, at the meeting of May 3, 1880, that he wished to offer a Prize, to be awarded every third year under the auspices of the Academy, the amount to be \$250. Subsequently, by bequest,

he established the Samuel D Gross Prize of the Philadelphia Academy of Surgery, to be awarded every fifth year "to the writer of the best original essay, not exceeding one hundred and fifty printed pages, octavo, in length, illustrative of some subject in Surgical Pathology or Surgical Practice, founded upon original investigations, the candidates for the prize to be American citizens" The amount of the award is now \$1500 Under this bequest seven awards have been made up to the present, and all but one of the recipients have complied with the provision established by the testator that the essay to which the prize has been awarded shall be published in book form by the competitor who receives the prize

Doctor Gross also bequeathed to the Academy his personal library, this, known as the Samuel D Gross Library of the Philadelphia Academy of Surgery, was, in the year 1884, placed on permanent deposit with the Library of the College of Physicians of Philadelphia From the very beginning it has been the custom of the Academy to hold its meetings in one of the rooms of the building of the College of Physicians, and the care taken of our Library by the Librarian of the College, Mr Charles Perry Fisher, and by the successive Library Committees of the College, has amply justified the Academy in having thus permanently secured such efficient custodians of its valuable collection of books Additions to the Gross Library have been made from time to time, by gifts of books and money from members of Doctor Gross's family, and by funds provided by vote of the Fellows of the Academy According to the last Report (1928) of the Library Committee of the College of Physicians, there were at that date a total of 3755 volumes in the Gross Library Those volumes which comprised Doctor Gross's original library are kept in the Gross Library room on the ground floor of the building in which we are now meeting, accessions are housed in stacks, along with volumes of the College library

Doctor Gross, himself a "self-made man," set high value upon education, upon study, research, and upon teaching The commanding position which he occupied in the surgical profession not only of this country, but in most of the countries of Europe as well, is recognized to this day It was to his foresight, to his power for organization, to his limitless enthusiasm for the profession of surgery, and his determination to see it established in this country upon a sure and lasting foundation that we owe not only the existence of the Philadelphia Academy of Surgery, but also that of the larger and still more influential national society, the American Surgical Association By natural right he became the first president of both these societies

It is partly because we, of the Philadelphia Academy of Surgery, have inherited from Gross a view of broad horizons, but also partly because they are our friends, that we have invited three distinguished American Surgeons—one each from the North, the South, and the West—to take the major part in our program of this Semi-centennial Meeting

ACUTE ŒDEMA OF THE PANCREAS¹

A CLINICAL AND EXPERIMENTAL STUDY

By EDWARD ARCHIBALD, M.D.

OF MONTREAL, CANADA

I HAVE to speak today on the subject of a certain phase of pancreatitis, which has not been much studied. It was brought to my notice through experimental work upon the etiology of acute pancreatitis. Perhaps it can be introduced in no better way than by relating the protocols of two experiments.

Cat 258—I had introduced a tiny cannula into the pancreatic duct, through the opened duodenum. Upon allowing a small amount of clean gall-bladder bile, obtained by aspiration of the cat's own gall-bladder, to run into the pancreatic duct, watching at the same time the body of the pancreas, I was amazed to see with what rapidity the pancreas became congested and œdematous. Within a half minute one could observe the beginning of œdema, and within five minutes the greater part of the head and body of the organ was swollen, apparently to about half again its normal size, as the result of an acute, glassy, yellowish œdema, across which one could see running congested vessels. It looked almost translucent. The thin capsule of the pancreas was stretched out tightly as an almost transparent film.



FIG. 1.—Cat 258. Note the very greatly widened spaces of the stroma, indicating œdema. Also in the three small islands of pancreatic tissue, otherwise normal one can make out slight but definite separation of the tubules from each other as part of the same œdematous reaction.

Now, upon removing, after five or ten minutes, a cross section of the swollen œdematous area (See Fig. 1), and examining it microscopically, I found exactly the histological changes that the gross appearances suggested. The normal spaces of the stroma, interacinar as well as interlobular, stood out clearly under the microscope and were enormously widened. The vessels were choked with red cells, and one could also see some increase of white cells. Here and there one could find small extravasations of blood. In certain areas, not by any means in all (I speak now of the general run of similar experiments), one could see a change in the parenchymal cells. Either in the centre or in some other part of the group of cells forming an acinus, one could find areas of beginning necrosis, and this might be represented by no more than a cooked appearance of the protoplasm of a few cells, or might even be a definite necrosis of considerable extent. But in this specimen, in which clean, normal bile was used, necrosis was conspicuous, on the whole, by its absence, while œdema and congestion dominated the picture.

¹ Read before the Philadelphia Academy of Surgery, Semi-Centennial Anniversary, April 22, 1929.

A few days later, I reopened the animal, and was amazed to find hardly a trace of the original œdema. Upon section and examination under the microscope (see Fig 2),



FIG 2—Cat 258. There can still be seen the evidence of slight œdema between the tubules, but the stroma has become practically normal. These microphotographs represent fairly the general look of the whole section.

one could see the persistence still of a mild œdema, but on the whole the acini were densely packed together. One could see small collections of lymphocytic infiltration, some leucocytosis in the vessels, chronic congestion, but otherwise the gland seemed normal.

Here, then we had before us a concrete fact—the fact that clean bile which had invaded the pancreas would cause an acute reaction, stopping, on the whole, short of necrosis, and that, in spite of the presumed fact of activation of pancreatic ferments by the bile, the process would not go on to what we call, in the human, acute pancreatic necrosis, on the contrary, that the inflammatory out-pouring of plasma could be reabsorbed in a few days, leaving the pancreas practically normal.

Cat, March, 1929—Gall-bladder exposed, cystic duct ligated and cut between ligatures. Duodenum opened opposite the papilla, and cannula inserted into the common duct.

In the course of the next hour and a half, two cubic centimetres of a pale yellow, watery bile were obtained. Upon this a twenty-gauge cannula was inserted without difficulty into the pancreatic duct. The cannula was large enough to permit an easy flow of the liver bile just obtained into the duct without the use of any pressure, the syringe barrel acting practically as a funnel. One and a half cubic centimetres of the bile in this way ran into the pancreas by gravity, during the next three minutes, so that any mechanical lesion of the pancreas through excessive pressure of the injection could be excluded. There resulted an immediate glassy œdema, involving the body chiefly, and the head also to a minor degree. The last inch of the tail remained free.



FIG 3—Cat of March 1929. Another example of intense œdema, which under this low power, can only be seen in the stroma.

A section was taken from the body for microscopical examination. The picture is seen in the accompanying microphotograph (Fig 3), which shows an extraordinary degree of œdema, most marked between the lobules, but also present between the acini inside the lobules.

On the sixth day after operation the abdomen was reopened and the pancreas

ACUTE ŒDEMA OF THE PANCREAS

examined The glassy œdema had quite disappeared, and there remained but little of the general swelling of the organ Another piece was removed for microscopical examination, and the picture of the histological section corresponds with the gross appearance The lobules are now set close together, œdema has disappeared, and in particular cell necrosis is conspicuous by its absence (See Fig 4)

These observations, I may say, have many times been repeated, and one was able finally to arrive at the conclusion that when bile was not infected, whether it was mixed with mucus from the gall-bladder or came from the common duct as liver bile, unmixed with mucus, its entrance into the pancreatic duct was not likely to cause more than this acute pancreatic œdema, with congestion, which was capable of subsiding, and usually did subside completely within a relatively short time On the other hand, if the bile were infected,

whether mixed with mucus or not, it was likely to cause a much more intense effect upon the pancreas, chiefly in the way of extensive necrosis of parenchymal cells, considerable extravasation of blood, marked leucocytosis, and often secondary bacterial infections Concerning these graver lesions I do not wish at this time to speak My subject rather is the lighter forms of acute pancreatic œdema, undergoing prompt resolution, and my thesis, which I may as well state now, is this That in the human there does occur an



FIG 4—The legend of Figure 2 applies equally to this section

analogous condition to that described in the animal, that this condition is almost certainly due to the entrance of bile into the pancreatic duct under abnormal circumstances, and that the œdema in like manner may subside rapidly The hypothesis assumes further that this pathological condition constitutes the most probable explanation available for many of those attacks of more or less severe epigastric pain, which are met with so frequently in clinical practice, and which remain unexplained, at least to the satisfaction of the careful medical man Such attacks are set down rather vaguely, and have been set down in the same way for hundreds of years, to indigestion, gastric upset, gastritis, neurosis or neuralgia of the stomach, intestinal dyspepsia, indiscretions of diet, and so on They have been set down also, in late years, to some trouble in the gall passages, usually to stone For the most part, subsiding as they do within twenty-four to forty-eight hours, the true diagnosis remains undiscovered The patient may have many such attacks, and comes to speak familiarly, sometimes tolerantly, of his "indigestion" Naturally, patients suffering from these

comparatively transient symptoms are not brought to operation. Even when the diagnosis is made of abdominal colic, it is the rule to temporize, to give morphine hypodermically, and to wait until the attack has passed off. The attack does pass off, and when operation is performed in the interval, for presumed recurring attacks of gall-stones, the surgeon finds frequently, it is true, the expected gall-stones, *and* a normal pancreas. Naturally the pancreas seems normal, and probably is normal, the œdema has disappeared and there is nothing left to show that the organ, no longer than three or four days previously, was perhaps twice its normal size, and filled with a glassy œdema.

And another explanation of this failure to recognize the pancreatic change will doubtless suggest itself to you. Take that unfortunately large group of cases in which an exploratory laparotomy for undiagnosed acute abdominal conditions is done, and the wound is closed without the discovery of any satisfying lesion. Consider particularly the enormous number of rules of thumb operations for supposed appendicitis, in so many of which the removal of a normal-looking appendix constitutes the only reward (of the spirit, I mean), and to the patient a most dubious consolation for the distress of operation. May we not assume that a fair proportion of these are in fact cases of this same pancreatic œdema? For if the surgeon is not alive to the possibility of pancreatic œdema, and if his incision is made in the lower half of the abdomen or indeed even in the upper half, it is almost inevitable that he will fail to discover the pancreatic swelling, the more so in that fat necroses are rarely present, and the pancreatic enlargement may not be great.

But you may well ask what proof have we that such a series of events in a case of this sort actually occurs in the human. My present conviction that it can and does occur was established twenty-one years ago, upon the occasion of operating upon a patient for a severe epigastric attack of pain which I had diagnosed as being due to acute pancreatitis. I will read you his case report.

The patient, a man, twenty-six years of age, first entered the hospital in September, 1907, with an acute attack of abdominal pain, so severe that half a grain of morphia relieved him very little. The pain was generalized over the whole abdomen. He recovered shortly and nothing was done. The diagnosis on admission was appendicitis, but this was altered to pancreatitis before discharge. He was readmitted on November 28, 1908, a year later, having had meanwhile seven or eight similar attacks, in all of which pain was so excruciating that large doses of morphia had practically no effect. The last attack began on November 24, at 11 P.M., with sharp, shooting pain in the epigastrium, followed two hours later by a dull pain across the lower half of the abdomen. Vomiting followed. During the three days before admission, the pain remained very severe, and in spite of heavy doses of morphia he could not sleep. He was unable to remain still, and the position in which he found most relief was prone on his face. The abdomen was found to be rather scaphoid, moving freely with respiration, symmetrical, and on palpation soft, no mass could be felt, but there was great tenderness in the epigastrium, if anything more marked to the right of the median line, though extending also to the left. There was occasional vomiting of bile-stained fluid. The stomach was not dilated. The bowels had not moved. The leucocyte count was 11,600, and a differential count revealed nothing abnormal. His urine was normal. On examining him for skin anesthesia, a Herd zone was found on the trunk, extending in the form of a band about two inches wide about the level of the umbilicus, transversely from the

median line anteriorly, across the left side of the abdomen, to the median line posteriorly. Examination of the urine by Doctor Bruère, for lipase, showed that the urine caused marked hydrolysis of 55 cubic centimetres of butyric ether, in twenty-three hours, demonstrating that lipase was present. Control sample, boiled for ten minutes, was without action on butyric ether. Otherwise there was nothing relevant in the general examination. A diagnosis was made of acute pancreatitis, and operation carried out on November 30. By this time the condition was rapidly subsiding. Upon opening the abdomen the following observations were made. The peritoneum showed no signs of inflammation, the liver appeared healthy, the gall-bladder was partly filled with bile, seemed quite normal, and did not contain stones. The common duct was palpated and nothing found in it. The stomach and duodenum appeared normal, but the pancreas was decidedly firmer and larger than normal, and the enlargement involved practically the whole organ. It was not, however, exposed for direct inspection. A thorough examination of the rest of the abdomen, including the kidneys, spleen, cæcum, appendix, transverse and descending colon, revealed nothing abnormal. There were, however, a few palpable glands at the root of the mesentery. No peritoneal adhesions could be found.

At that time I had not come to formulate the principle of prolonged bile drainage as a therapeutic measure for the condition of pancreatitis, so that I closed the abdomen without doing anything more. Within two days the pain had practically disappeared, and he made an uninterrupted recovery and was discharged, feeling quite well, on December 18. The urine was examined by Doctor Bruère on December 8, who reported that no lipase was present.

On January 11, 1909, the patient was readmitted. He had remained quite well until about midnight on January 9, when he was awakened by a very severe pain, which began in the abdomen but soon extended all over the body, especially in the back and in the arms. The pain was excruciating and shortly he vomited. In the morning he felt better and got up, but the pain recurred with renewed violence, morphine was administered, three-eighths grain, and he obtained partial relief. The pain continued through the night, with vomiting, and he was admitted to the hospital on the morning of the 11th. Upon examination one found very marked tenderness in the epigastrium and also moderate tenderness over the whole abdomen. Upon careful thumb pressure there was found an area of extreme tenderness about two inches wide, midway between the umbilicus and the ensiform cartilage, extending from one inch to the right of the mid-line, to two and a half inches to the left. No mass could be felt. His pain was still severe, and continued so through that day and the following day. Morphine was given in doses of half a grain, five times in all, up to the evening of January 12, and he vomited several times. On the 13th he was better, although still suffering much pain in the back and shoulders. On the 15th and 16th he completed his recovery and was discharged apparently well. His temperature was practically normal throughout, save that on the 14th it went up to 101°, but came back to 99° on the following day. This corresponded with a fresh attack of moderate severity, which shortly disappeared after the exhibition of one-half grain of morphine. In the idea of adding an antiseptic to his bile, he was given urotropin, ten grains, three times a day, and was instructed to take it for three weeks, at which time he was to report. The urine on this occasion was not examined for lipase. The patient did not return for observation, and was lost sight of, but about a year later the medical officer of an insurance company sent in an inquiry, as the man was applying for insurance. It was then learned that he had, in the meantime, suffered one or more further attacks.

Here, then, we have an instance of a light attack of pancreatitis without coincident gall-stones or any other obvious cause, diagnosed clinically before operation, and apparently subsiding without treatment. Nothing was done at this operation on account of my ignorance of any promising mode of treatment, and the abdomen was simply closed. Although at the time I did not

expose the pancreas for direct inspection, I have no reason to doubt that a transitory lesion of the organ was the cause of his symptoms, and that that lesion was in the nature of an acute œdema and congestion, such as was later demonstrated in animal experiments. A year or two of experiment brought deeper knowledge, and, if he had returned, I should have drained his gall-bladder for one or two months, but he disappeared, and efforts to trace him were unsuccessful.

Since that time I have had, or at any rate taken, no second opportunity of operating on a comparable case. It is rare when a patient suffering from an acute attack of epigastric pain, which lasts no more than a few hours, is brought to the surgeon for operation. The comparatively early subsidence of the pain encourages the attending physician to wait, and the marked improvement, or even entire disappearance of symptoms on the following day, decides the surgeon against an operation which would then be only exploratory. On the other hand, the usual diagnosis under these circumstances is gall-stones, and inasmuch as it has for long been considered sound policy not to operate during an attack of gall-stone colic—a rule which is as strong in the mind of the surgeon as in that of the general practitioner, operation is not undertaken at the very moment when a secondary or even independent pancreatic œdema might be found, but only later, during the interval, when all pancreatic swelling has disappeared, or, on the other hand, during a prolonged acute attack when the pancreas is found to be the site of a grave and advanced pancreatitis. In other words, the surgeon usually misses exactly that stage at which a light grade of pancreatitis, with œdema, would, or might, be seen. Nevertheless, when one comes to analyze carefully the case histories of patients who are operated on finally for gall-stones, or for severe pancreatitis, or for both, one very frequently discovers an account of one or of many previous attacks, passing off within a few hours or a couple of days. While it is natural to ascribe such previous attacks to gall-stones, it often happens that no gall-stones can be found, and it becomes obvious that such previous attacks could be hardly anything else than mild attacks of pancreatitis, consisting presumably in this very condition of pancreatic œdema with congestion. I feel sure that the thoughtful surgeon has for long formulated such a conception in order to explain these previous mild attacks. But it is also true to say that the great majority of practicing physicians think of pancreatitis only as a most severe and dangerous disease, usually ending fatally. It is curious to notice how this attitude of the general practitioner coincides with that of the pathologist, and in the case of both because of insufficient experience. Every now and again it happens that a patient who has been operated on, let us say for disease of the gall passages, comes to autopsy after a few days or more, and the surgeon concerned, who has, as he thought, distinctly felt an enlarged pancreas, makes a point of asking the pathologist concerning the condition of the pancreas, and is amazed to hear the simple, yet positive answer, that there was nothing wrong with the pancreas. Upon expressing his surprise, the pathologist, with that superior air which characterizes those of his profession as being men

who deal with demonstrable facts, merely shrugs his shoulders and suggests that the surgeon's conception of an enlarged pancreas was at fault. For, says he, tolerantly, and with a faint tinge of amusement, the pancreas is susceptible of many variations in size within normal limits. The result has been that many surgeons have come to distrust their opinion in such cases, and will set down in their report the note of an enlarged pancreas only when the enlargement is so gross that nobody could be of any other opinion. Only here and there does one find a surgeon who, being called upon to recant and confess, is of such an independent spirit as to exclaim, like Galileo, "*Eppur si muove*—it was swollen, anyhow!" Now the truth of such a matter, of course, is that both are right, but that the œdema, which increased the size of the organ to such an extent that the surgeon could feel it as enlarged, had disappeared during the intervening few days to such an extent that the pathologist would consider it normal.

Although such a pancreatic œdema is not infrequently found as a complication of gall-stone disease, it can also occur quite independently. In a series of some thirty-five cases of chronic pancreatitis which I analyzed in 1913, I found that, in approximately 50 per cent, gall-stones were conspicuous by their absence, and that in a further considerable proportion stones were present only in the gall-bladder and not in the common duct. And, indeed, this fact has long been a difficulty to those who roughly think of pancreatitis as being always secondary to disease in the gall passages. It was in the attempt to explain this large proportion of cases of independent pancreatitis that I suggested, about 1911, that bile might be forced into the pancreatic duct through a spasm of the sphincter of Oddi. This is a hypothesis which it is extremely difficult to prove in the human, but which I have been able to prove in animal experiments, and I confess that I am a convinced adherent of the theory which ascribes the cause of the great majority of instances of acute pancreatitis to the entrance of bile into the pancreatic duct. In this place I need say no more about this mode of causation than that I have found it possible in animals, by direct injection of bile, both normal and infected, into the pancreatic duct, or by forcing bile through an artificially induced spasm of the sphincter of Oddi into the pancreatic duct, to produce all grades of acute pancreatic disease, from the lighter forms, which are here in question, up to the hyperacute forms ending fatally within half an hour from the beginning of the experiment. And concerning the lighter forms, I have observed again all stages from a very mild and transitory œdema, with little congestion, limited to a small area of the gland, up to massive œdema of the whole organ, with intense congestion, small extravasations of blood, and here and there small areas of necrosis of the parenchyma, but all stages of these lighter forms may alike end in recovery, more or less rapid, through subsidence of œdema, reabsorption of hæmorrhagic exudate, and conversion of the small necrotic areas into scar.

Now, is confirmation to be found in the literature? I cannot pretend to have covered the subject exhaustively in my reading, but I have found one

article at least. In the *Deutsche Zeitschrift für Chirurgie*, for 1922, there appeared an article by Zœpfel, the title of which ran thus "Acute pancreatic œdema as an early stage of acute pancreatic necrosis." Zœpfel points out that the fundamental lesion in acute pancreatitis is the necrosis of the gland tissue, and this is now generally accepted. Early or light cases of the disease are those in which necrosis and possibly hæmorrhage are not only definitely present, but are also in process of further development. Zœpfel here set up a new class upon the basis of an experience of four cases, in which he found a picture which undoubtedly belonged in the rubric of acute pancreatic necrosis, although lacking the basic lesion of necrosis. In each of these four patients he discovered no more than a glassy œdema, which completely infiltrated and enveloped the pancreas, and invaded also the small omentum and the transverse mesocolon. The gland tissue was moderately swollen and hardened, but looked otherwise normal, and in the microscopical sections, which he obtained by cutting out in two cases a small piece of the organ, he was able to demonstrate an entire absence of necrosis, as also of hæmorrhage. In two of these, fat necroses were also found. He goes on to argue that this condition of acute œdema represents the earliest stage of a proper, acute pancreatic necrosis, and, what is more, that the process would infallibly have gone on into a full-blown pancreatic necrosis had he not intervened early. "The discovery of this condition (he says) of acute pancreatic œdema, and above all its successful management, I owe entirely to the principle of immediate operation during the ordinary gall-stone attack." All four patients recovered and all four were operated on within the first twenty-four hours, and indeed three within the first twelve hours. He assumes that his early operation came in time to prevent further progression into the stage of fully developed and possibly widespread necrosis, and he, therefore, demands that operation should be undertaken as soon as there is any suspicion of acute pancreatitis. Suspicion should be aroused immediately whenever, in the course of assumed cholelithiasis, an attack appears in which the most severe pain is found in the middle and left side of the upper abdomen, together with great tenderness and rigidity in this region. In 115 operations undertaken during the acute stage of a gall-stone attack, he found eleven cases of acute coincident pancreatic necrosis, including his four cases of œdema.

The finding of this paper of Zœpfel's was a source of considerable pleasure, for I discovered here the confirmation of my long-held conviction, which up to that time was supported only by the experimental work and the experience of the one case. I take it, therefore, that this picture, both pathological and clinical, may be now accepted as a distinct disease entity. I am under the impression that it is not generally familiar to medical men, but I imagine that nobody will deny its importance. One may contest, as indeed I do contest, Zœpfel's assumption that this pancreatic œdema will go on, usually, into the extremely dangerous condition of widespread necrosis, without thereby diminishing the importance of his observation. A very large number of these œdemas would resolve spontaneously within a few days, if left alone. How

often have we not seen even more advanced lesions in the pancreas, discovered by chance during gall-bladder operations, recover spontaneously without any such intervention as drainage or tamponing the pancreas! Is this not all the more true of the lighter lesions of pure œdema! By the terms, therefore, of this argument, we are brought back to the conception of a passing pancreatic œdema, caused by the accidental reflux of fairly normal bile into the pancreatic duct, as explaining many of the transient though possibly severe attacks of epigastric pain, often spreading to the left side (though that is not necessary), which are variously diagnosed as indigestion, gastric upset from improper diet, adhesions, ulcer, cholecystitis, appendicitis, or even renal colic. I admit that the diagnosis in such cases must often remain quite uncertain, but I maintain that merely to have in mind the possibility of pancreatic œdema is useful. For it is rather characteristic of this form of pancreatic disturbance that it is apt to be recurrent. The surgeon will not by his training dismiss lightly any complaint of a recurring trouble in the abdomen, which is accompanied by pain, but the general practitioner, familiar as he is with so many pains that come to nothing, and driven by the pressure of practice, is perhaps more apt to do so. Such patients should be thoroughly and methodically examined. Gastric and duodenal ulcer can usually be excluded, likewise, appendicitis. The finding of disease in the bile passages does not exclude, indeed, may rather support, the idea of coincident attacks of mild pancreatitis. In any case let us finish once for all with such vague generalizations as those just mentioned.

But, one may ask, are there no means by which we can attain to greater certitude in the clinical recognition of these cases of pancreatic œdema, or mild pancreatitis? I think there are. Certain clinical signs and symptoms do point to the pancreas. First the situation and character of the pain. A pain which is chiefly felt in the epigastrium and radiates to the left and especially into the left side of the back, while the right side of the abdomen remains comparatively free, and a pain which is of extraordinary severity, is most probably a pancreatic pain. It is commonly believed that the pain of a gall-stone attack often radiates to the left side. That is true, although Katsch and also Westphal deny it. Nevertheless, gall-stone pain is chiefly felt on the right side and radiates to the right shoulder-blade, and only when excessive and at the onset, to the left, it is easy to make sure that its *chief* location is in the mid-epigastrium and to the right. Pain which *persists* in the left side usually indicates a pancreatitis. The location of tenderness is also a good guide, but it is important to use thumb pressure and to work in from all sides toward the pancreatic area, marking the point at which the patient first evinces pain. It is remarkable how often the resulting figure will correspond with the anatomical situation of the pancreas. In some cases one will find an abnormally superficial aortic pulsation, which is most important. In many acute cases, a zone of left-sided hyperæsthesia (Head) is found, and points strongly to pancreatitis. In a gall-stone attack the zone is not found on the left. It was typically present in my case.

Tests for pancreatic function are gaining more favor lately. Wohlgemuth's test for diastase in blood and urine has been employed in a large number of cases in Germany, and is much thought of. Before the war, working with Doctor Biuere, I found that Hewlett's test for lipase in the urine was positive in over half the cases. And of late years the finding of a raised blood sugar is more and more frequent. But it is important that all these tests should be applied early, within the first forty-eight hours, later than that they usually fall out negative. I feel sure that the early generalized swelling of the whole organ is often sufficient to interfere with both internal and external secretions, but the lapse of even two days allows of sufficient reabsorption of cedematous fluid to set free the pancreatic tissue and the excretory paths. Thus then, even in these light attacks of pancreatic cedema, it is possible for the alert clinician to make a very good guess at the true condition. Abnormally severe epigastric pain, radiating to the left, persistent epigastric tenderness on finger pressure, limited to the anatomical position of the pancreas, a Head zone of hyperæsthesia in the left flank at the level of the eighth to the tenth dorsal, a transient hyperglycæmia, a positive test for diastase or lipase in the blood or urine,—all point only in the one direction, the pancreas. And if within a few days all these signs disappear, that very disappearance, corresponding to reabsorption of the pancreatic exudate, is a further link in the diagnostic chain.

Treatment—The undoubted fact that the condition just described does not often progress to the stage of massive pancreatic necrosis, that it rather tends to spontaneous subsidence, would seem to suggest an expectant plan of treatment, yet the equally well-established fact that any one of these attacks may end in a fatal massive necrosis constitutes a grave warning, and will often justify operation. The diagnosis being established, one should, in my opinion, open the abdomen. When the lesion is apparently due to disease in the bile passages this will itself be a sufficient reason for operation, and the course to be followed is obvious. One will remove stones and drain the bile. With regard to removal of the gall-bladder, so universally, even indiscriminately practiced of late years, my opinion is that in the presence of pancreatic swelling a cholecystectomy is not permissible. With increasing experience we are finding that pancreatitis occurs not infrequently after the gall-bladder, with its valuable safety valve function, has been removed. Von Bergmann estimates the incidence of recurring pain after cholecystectomy at 20 per cent. While this is due in some cases to the fact that a common-duct stone was overlooked at operation, we know that in many other cases this explanation is not applicable, and it is necessary to assume that some disturbance in the peristalsis of the common duct, conceivably a spasm of the sphincter of Oddi, is responsible. It is obvious that such an occurrence would tend to throw bile into the pancreatic duct, and produce a mild or severe attack of pancreatic swelling. Our only safeguard under such circumstances lies in a bile drainage, and if the gall-bladder has been removed the common duct has to be utilized. We must then perform an operation which is tech-

nically more difficult than a cholecystostomy, and not without danger. If bile drainage has to be maintained for a month or two, as in my opinion it should be maintained, in order to allow time for the pancreatic swelling to resolve, we are faced with the trouble and risk of leaving a tube in the common duct over a long period, with consequent danger of stricture and with, also, whatever danger may lie in the diversion of the total amount of bile to the exterior. Consequently, I do not remove the gall-bladder for cholelithiasis in the presence of pancreatitis, but use it rather for prolonged drainage, which in my experience has been the surest road to cure.

If, on the other hand, no stones are found in the common duct or gall-bladder, and we have to assume a dyskinesia of the motor apparatus of bile excretion, we are at least following the safest course in instituting bile drainage through the gall-bladder, for this provides a safety valve for any transient, increased pressure in the common duct, and thereby tends to prevent a forcing of bile into the pancreatic duct.

In conclusion, therefore, I would urge that operation, under the circumstances described, is advisable, and that it should consist, when the pancreas is found swollen, in a cholecystostomy with bile drainage maintained for a period of one to two months, according to the degree of the pancreatic swelling, giving sufficient time, that is, for resolution of the pancreatic exudate to take place thoroughly.

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DISCUSSION

DR DAMON B. PFEIFFER said that the interdependence of certain inflammatory lesions of the abdominal viscera has long been recognized, especially by the surgeon who sees the forces of pathology in motion. The exact sequence of events, the precise determination of the pathogenesis of these processes, is in many cases not fully settled. This is particularly true of the acute and chronic lesions of the pancreas. Doctor Archibald's long interest in this subject and his contributions to it lead us to receive his findings and opinions with great respect.

It is undoubtedly true that the majority of attacks of pancreatitis at the

present time go unrecognized and misinterpreted. In reviewing the histories of cases of acute pancreatitis, the speaker has been impressed, by the frequency of previous attacks, milder in character but similar in kind to the final and too often terminal one. The failure to recognize the nature of such preliminary attacks finds a ready explanation if not an excuse in the lack of truly characteristic symptoms and signs of pancreatitis, in the absence of definite laboratory or other confirmatory methods and in the frequent preponderating admixture of symptoms of involvement of the biliary tract. Probably the situation will remain unsatisfactory until definite confirmatory methods are devised or until we gain a better knowledge of the true origin and incidence of the disease. Certainly early operations as advocated by Zoepfel would help greatly in unravelling the skein but it seems doubtful whether surgeons can be convinced that early intervention should be practiced in the acute calculous or non-calculous infections of the gall-bladder. Unless the risk of acute pancreatitis is greater than experience seems to indicate, it would seem that the greater risk involved in precipitate operation upon acute biliary disease would more than counterbalance the advantages to the pancreas. Surely Zoepfel's experience in finding 10 per cent of cases of severe pancreatic disease in a series of a little over a hundred gall-bladder cases is exceptional. However, even without such purposeful early operation, it has fallen to the lot of every active abdominal surgeon to operate upon cases of more or less acute cholecystitis or cholelithiasis and to find the pancreas involved in the process. Allowing for the difficulties and personal equations involved in assessing the differences in size, contour, and consistency which would indicate pancreatic involvement the testimony of many surgeons of large experience and undoubted competence indicates some degree of participation by the pancreas in a considerable percentage of cases even up to 20 or 30 per cent.

Some years ago Arnsperger abroad and Deaver and the speaker in this country advanced the idea that the lymphatics of the head of the pancreas which are known to be in such intimate relation to those of the gall-bladder, liver, and duodenum might be the connecting link. The idea does not lend itself readily to experimental proof or disproof because of our inability to construct conditions comparable to the clinical state of affairs. However, the clinical inferences were attractive and gained some degree of acceptance. Now Doctor Archibald brings us back to the older idea of retrojection of bile and duct-borne infection as the probable explanation of both the acute and the mild and presumably chronic inflammations. It is healthy to have this divergence of opinion, and it is illuminating to see this demonstration and hear his views so ably expounded.

Doctor Pfeiffer has felt for a long time that it is probably a mistake to try to explain too much on a single hypothesis, that the solution probably involves multiple factors. Certainly there can be no doubt of the harmful influence of retrojected, infected bile upon the pancreas. That this can and does occur when a stone of a certain size is impacted in a certain way

in the papilla of Vater of a certain type of anatomical construction, we know That pancreatitis occurs without stone is also known Archibald's experiments upon the cat, however, have shown that the obstruction to the outflow of bile by the sphincter of Oddi may permit the pressure of bile within the ducts to be raised to a point such that bile may be injected backward into the pancreas This disposes of that objection to the duct theory But instances of pancreatitis have been reported in which the pancreatic duct did not join the common bile duct but passed directly into the duodenum and at least one instance of acute hæmorrhagic pancreatitis has been reported in an accessory pancreas Possibly retrojection of duodenal contents may account for the latter cases There is no way of dodging the incorrigible duct advocate Those who have seen the œdema and infiltration of the peripancreatic tissue in association with certain cases of cholecystic disease, together with obvious alterations of the pancreatic head, may be pardoned for feeling that infection by lymphatic channels and contiguity is at least a probable factor Possibly even a rapprochement of the two views may be possible in postulating stasis of pancreatic secretion due to inflammatory involvement of its terminal ducts where they are in close relationship with the termination of the common bile duct and in fact I strongly suspect that such is the case

In any event the blame is still cast upon disease of the biliary tract The chief offender is known The pancreas suffers the frequent fate of the innocent bystander, only we do not know whether the brick was thrown overhanded or underhanded When we do know, it may help us in the therapy of a not too satisfactory condition Hence, the great importance of this communication and the necessity for renewed interest and activity in the gathering of data that will help to clear up this debatable point It is the speaker's opinion that the solution of so-called pancreatitis involves not a single method of pathogenesis but multiple factors as above mentioned and that the apportionment of their relative importance is yet to be made

DR J EDWIN SWEET, of New York, said that he had had some evidence of Doctor Archibald's contention that it is possible to have something less than a fatal pancreatitis Most of those who have worked with the pancreas were misled by the early workers on the pancreas, who were not surgeons or pathologists, but generally German coroners, whose experience would naturally make them feel that pancreatitis is a fatal disease

A few years ago in connection with Doctor Krumbaar some experiments were tried with radium emanation tubes in the pancreas The experimenters found that they could produce areas of typical hæmorrhage of the pancreas If a sufficient amount of emanation were used, the result was fatal, with fewer tubes inserted into the pancreas the result was not fatal Doctor Sweet has felt since then with Doctor Archibald that non-fatal pancreatitis, with areas of typical hæmorrhagic pancreatitis, is possible The speaker asked by just what route Doctor Archibald pictures the passage of this bile from the inside of the duct to the lymphatics in the interacinar

space It would seem that by way of the duct it should first attack the parenchyma, but in his pictures it looks as if it went into the connective tissue first

DR A P C ASHHURST remarked that he should like to know whether this acute œdema which Doctor Archibald describes is an inflammation of the ducts of the pancreas, or a cellulitis, or a lymphangitis The slides he showed looked like cellulitis Doctor Pfeiffer spoke of the lymphatics It seems to me important to decide which it is

DOCTOR ARCHIBALD closed the discussion of his paper by remarking that he had not intended the paper to be the basis of a discussion on the etiology of pancreatitis and for that reason he had tried to avoid contentious points, but almost inevitably, in any discussion one comes back to the old argument concerning the essential factors of etiology He can hardly be blamed for being an adherent of the bile retrojection theory in the face of the results he has seen from the direct injection of the pancreatic duct with bile The connection is so obvious, in animals at least, it is a definite cause and effect sequence, without any chance of mistake Whether it occurs that way in the human in the majority of cases remains a problem

Doctor Sweet asked how he explained the transfer of bile, or the bile effect, from the main pancreatic duct and intralobular passages to the stroma He was speaking, of course, only of œdema Œdema represents an inflammatory reaction, which invades all the tissues of any organ or any one part of that organ, because it occurs in the vascular tissue which permeates the organ Irritation of the ducts produces the phenomena of inflammation of which œdema is one of the first and most prominent It must occur in any or in every tissue, wherever the irritating substance comes into contact with the vascular radicles The speaker finds no difficulty in believing that an irritant introduced into the duct system, without necessarily penetrating the duct wall, can bring about a condition of œdema in the stroma as a phenomenon of inflammation More than that he cannot say

Answering Doctor Ashhurst's question, Doctor Archibald said that he believes it is purely an œdema, inflammatory but not infective like an aseptic inflammation which one may get from the injection of croton oil, but stopping short at the first stage of inflammation which is, let us say, exudation Whether the irritant gets in by any of the ducts in human cases, we cannot prove But in animals when he introduced it by way of the ducts, he obtained the appearance shown on the slides If he introduced infection from outside, say in the gall-bladder, and tried to get the lymphatics to carry it to the pancreas, he was not successful As to the blood current as a path for the irritant, that is extremely difficult to prove

DECOMPRESSION OF THE HEART^{*}

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DECOMPRESSION has become a recognized therapeutic principle in neurological surgery to relieve the brain of the serious destructive effects of pressure. Similarly the dramatic effects of decompression of the thorax have been noted repeatedly when air has been aspirated from a case of acute tension pneumothorax or when a large collection of fluid has been removed from a pleural cavity. The idea, however, of deliberately attempting to relieve the heart of embarrassing pressure has seldom been proposed, except as it has been applied to the removal of exudates within the pericardium which were causing the condition of so-called "heart tamponade."

The purpose of the present paper is to record two cases in which operations were performed for the deliberate purpose of decompressing the heart. Before giving the details of these cases, however, certain other aspects of the problem should be mentioned. First of all, there is but little information available on what the effects of pressure upon the heart are. This neglected field of study probably offers a rich harvest to those who will carry out properly controlled experiments. Dr. Duff Allen and I are now interested in this problem. So far as I have been able to find there is only a single observation in the literature in which experimental studies have been made of this question with satisfactory control. This was an observation made by Schmitt¹ during the course of some experimental work on partial heart block carried out in the Department of Physiology of the Washington University School of Medicine. He found that a complete block of the conduction of the contraction wave through an isolated strip of turtle heart muscle could be obtained merely by the pressure upon it of a thin strip of rubber dam. If such effects can be produced on a strip of normal muscle, it seems possible that serious effects may follow even less degrees of compression exerted on muscle which is already somewhat compromised by disease.

Normally the heart, enclosed in the pericardium, is partly surrounded by the lungs, which act as two air cushions. This fact might seem perhaps to indicate that nature had made provision against a serious compression of the heart at least from the sides. Moreover, the heart is ordinarily movable to a considerable extent and its mobility affords another possible means of protecting it against serious pressure. Although these protective mechanisms suffice under ordinary normal conditions, yet there seem to be cases in which the heart is subjected to a pressure which appears to be great enough to cause potential harm. These are the cases of children in whom there is a precordial bulging with widening of the intercostal spaces and sometimes apparently a

^{*} Read before the Philadelphia Academy of Surgery, Semi-Centennial Anniversary, April 22, 1929.

pushing forward of the ribs and costal cartilages on the left side. Under ordinary circumstances, in a child the bony thorax grows larger at about the same rate as the heart. However, in a child whose heart is greatly enlarged from rheumatic heart disease, it would seem that the thoracic cage may actually be too small. The heart, moreover, will continue to enlarge because of the demands of mere growth itself. Under such conditions as those described above it has seemed to me that perhaps some relief might be expected from an operation which would diminish the pressure exerted on the organ by the bony and cartilaginous wall of the thorax.

Brauer² in 1902 proposed to Peterson that the third, fourth and fifth left ribs should be removed in a case of chronic mediastinopericarditis in order to permit the heart to contract without the necessity of pulling on the rigid wall of the chest. The operation was carried out with conspicuous success by Peterson, and to it the name of cardiolysis was given by Brauer. The idea, strictly speaking, was not to accomplish decompression, but rather to permit the heart more freedom in action by allowing it to pull against soft yielding tissues instead of against a rigid bony wall. An exhaustive review of all the cases in the literature operated on in accordance with the principle of the Brauer cardiolysis has recently been made by Elsworth Smith and H. S. Liggett³. In 1907, however, Alexander Morison⁴ of Edinburgh, in ignorance of Brauer's ideas, proposed "the principle of operative interference to relieve intrathoracic pressure when the mere bulk of the heart was the chief feature in the case." After hearing of the successful result in the first case of cardiolysis by Brauer and Peterson he concluded that perhaps the benefit derived from the operation was not entirely to be explained in accordance with the ideas of Brauer, but that perhaps also the factor of actual decompression was important. The following quotation is taken from his article:

"The question arises whether mere bulk is not a disadvantage in these circumstances, and whether, therefore, the justification does not arise for attempting to relieve pressure by the removal of a portion of the ribs and cartilages in the precordia, in obedience to the indications given by the precordial bulging of children, even when it may be assumed that pericardial tethering is absent."

Because of these ideas he persuaded Mr. E. C. Stabb, of Edinburgh, to carry out an operation similar to cardiolysis on a young man, nineteen years of age, whom he had been treating with only moderate success for six years previously for an aortic regurgitation with a greatly enlarged heart. This young man also had very severe precordial pain. The operation was well tolerated, and marked improvement occurred in the patient's condition, with almost a complete disappearance of the distressing pain. A subsequent report⁵ a year later stated that the patient had continued to show improvement and was able to work steadily as a hat maker.

There are possibilities of two kinds of serious compressive effects when a heart is greatly enlarged. One type of these effects is on the heart itself

As already indicated above we know very little about the consequences of pressure on the heart itself. The other type of effects is on other intrathoracic structures. We are much more familiar with the effects of compression on other structures than the heart. We know, for example, that the large veins can be rather easily compressed by intrathoracic tumors, by pneumothorax and by large collections of fluid. Still more recently we have learned through the important work of Alexander and Kountz,⁶ of Washington University, that the supposed cardiac decompression with its attending oedema of the extremities, the enlarged liver, etc., which sometimes accompanies conditions of extreme emphysema of the lungs, is not due to disease of the heart, but that rather it is due to the pressure exerted on the large veins by the greatly distended lungs. There are thus apparent many inviting problems for study in connection with the question of what may happen to a patient from a great enlargement of his heart.



FIG. 1.—X-ray photograph of heart of Case No. 1

In addition to the type of compression of the heart which arises from its too great enlargement in a restricted bony framework there is also another type in which the heart is squeezed by a pericardium which consists largely of scar tissue. As a result of inflammation the pericardial membrane sometimes becomes converted into scar tissue with dense fibrous adhesions between the parietal and visceral layers. When such a result occurs the action of the heart is inevitably embarrassed regardless of the question of size or of the state of the bony framework of the chest. At times this effect is even greater because the pericardium becomes actually calcified. For the relief of this condition Delorme, in 1895, proposed that in such cases some or all of the fibrous pericardium should be removed. This operation is often spoken of under the name of pericardial decortication. In 1924 he⁷ reported and commented upon two patients that had been operated on by Hallopeau. Sometimes it is impossible to carry out the idea of Delorme because the parietal pericardium is so firmly attached to the heart that it cannot be stripped off. Not only is this true because of calcification which may be present but there are also, occasionally, strands of fibrous tissue which run right into the myocardium from the fibrosed visceral pericardium. Schmieden⁸

has commented on these difficulties after an experience based on eight operations for decortication. He states that it is very important to remove the visceral layer, that is, the epicardium, in order to free the heart properly, and that it is very important to free the left ventricle before the right one. The Delorme operation is rational when it can be carried out and in certain cases the results have been most gratifying.



FIG 2—Case No. 1 two months after operation. The forward bulging of the heart is well seen in the photograph.

In this paper I am not discussing the question of a heart that is embarrassed by the contraction around it of a fibrous pericardium. I am discussing rather the question of a heart that may be embarrassed because it is so large that it cannot help being embarrassed by confinement within a bony chest wall. In the two cases reported here the pericardium was not thickened and in the second case it was intentionally opened to permit an inspection of the interior. No fibrous adhesions between the two layers of the pericardium were found and both layers seemed on inspection to be practically normal. This case, therefore, did not seem to demand the principle of decortication.

I have recently operated on two children for the purpose of accomplishing a decompression of the heart in accordance with the ideas expressed above.

The first patient, E. C., was a boy, fourteen years of age. Since the age of six he had spent most of his time in either the St. Louis Children's Hospital or at its convalescent farm because of frequent attacks of cardiac decompensation. In all he had been admitted to the Children's Hospital ten times in the past eight years. Sometime at about the age of five he had had, apparently, acute articular rheumatism. At the age of six his tonsils were removed and he had had many operations on his nasal sinuses. The patient stated that he stopped with the thirteenth operation on his nose. He has always since the beginning of his illness been very dyspnoeic even on slight exertion. He has been much annoyed by a constant pounding in the precordium and his sleep

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has been seriously interfered with because of palpitation of his heart. Because of having passed beyond the age limit of the Children's Hospital he was admitted to the Barnes Hospital August 27, 1928, with a return of symptoms of cardiac decompensation. Fibrillation which has been noted on numerous previous occasions was present at the time of this admission. There was a diffuse turbulent cardiac impulse extending about two inches outside the nipple. There was an apical systolic thrill and murmur. The rhythm and force of the beat were irregular. The rate was about 150 at the apex and about 120 at the wrist but it was difficult to count. The second pulmonic sound was accentuated. His blood pressure was 105/75. He was discharged on October 4 in compensation after digitalis therapy. He reentered the hospital on October 9 because of a return of some symptoms of decompensation together with vomiting. At this time the only evidence of decompensation, however, was the presence of râles at the base of both lungs. The liver was not enlarged and the peripheral veins not dilated. The fluoroscopic examination showed that both cardiophrenic angles were clear with no evidence of adhesions. The heart shifted readily from right to left with change of position. There was no Broadbent sign. From these findings it was concluded that there was no evidence of a chronic mediastinopericarditis. The question, however, of decompression came up and was discussed extensively with various medical colleagues.



FIG 3—X ray of chest of Case No. 2 immediately after the patient had swallowed barium. Not only is the greatly enlarged heart seen but the deviation of the oesophagus because of the pressure of the heart against it is also well shown. The numbers represent millimetres.

On November 5, with novocaine anaesthesia, the fourth and fifth ribs and costal cartilages, including the periosteum and perichondrium, were removed from the left border of the sternum to the anterior axillary line. The beating of the heart seemed much less restricted than before and the organ immediately bulged forward. The pericardium was not opened but seemed practically normal. The patient went through the operation in a very satisfactory manner, conversing and joking with various members of the operating team during the whole procedure. Immediately before the operation his blood pressure was 135/70. On the following morning it was 130/90, another reading thirty-six hours after the operation also gave the same value of 130/90. The most striking fact about the immediate result of the operation was the very marked subjective improvement. The patient stated immediately that the palpitation and the sense of pounding in the precordium had entirely disappeared. For that reason he was able to sleep much better than before. He was discharged from the hospital in the last week of December. His fibrillation was still present and was thought to be of a permanent nature. Although the subjective result is still excellent the patient has had another attack

of decompensation which was thought by his physician to have been due to too much activity. At the present writing he is in Barnes Hospital again with œdema and other signs of cardiac decompensation in addition to some evidence of a pulmonary infarct. However, despite his decompensation he still states that his symptoms are much more easily endured than they were before the operation.

The second case, M. R., a colored girl, five years of age, was admitted to the Children's Hospital December 31, 1928. There had been two previous entries in April and June of 1928 because of cardiac decompensation following several attacks of rheumatic fever. She showed evidence of a mitral stenosis and aortic insufficiency and a myocarditis. There was a marked precordial bulge with a very evident heaving of the whole precordium. The heart extended eight and one-half centimetres to the left, the liver was enlarged. On June 15 and 17 the patient had two sudden attacks resembling acute shock in which the pulse became rapid and thready and respiration rapid and shallow. There was some suspicion that this child had a chronic mediastinopericarditis with fixation of the heart by adhesions. However, about the only evidence of this was that which was presented by an electrocardiographic study of the heart with the technic of Carter and Dieuaide.⁹ There was no Broadbent sign and there was no systolic pull on the diaphragm noted fluoroscopically (Elsworth Smith sign). A swallow of barium showed a marked deviation of the œsophagus to the right. The measurements of the heart on a fluoroscopic tracing were as follows:

Widest diameter of the vessels	= 5.4 cm
Med. Right	= 4.25 cm
Med. Left	= 7 cm

On January 23 electrocardiograms showed arrhythmia and intraventricular block. There was also probably a nodal rhythm. There was thus a considerable amount of uncertainty as to whether or not this patient had merely an enlarged heart or an associated mediastinopericarditis. Compensation was restored and an operation was performed January 31, 1929, similar to the one which had been performed on the other patient. A semicircular incision was made beginning at the level of the second rib on the left side curving around the sternum and running backward to the anterior axillary line at the level of the eighth rib. The skin and subcutaneous tissues were turned back in a flap and subperiosteal resection of the fourth, fifth and sixth ribs and costal cartilages was made from the sternum to about the anterior axillary line. The periosteum and perichondrium were also carefully stripped off the pleura. This seemed an important part of the operation because if a permanent decompression is desired it is necessary to prevent regeneration of bone. The pleura was extremely thin and transparent but it was not opened at any place. The pericardium was seen plainly and the pulsation of the heart was regular. The pericardium was opened for inspection. Both layers seemed practically normal and there were no adhesions between them. Decortication, therefore, seemed unnecessary and was not performed. The pericardium was accordingly closed. There seemed to be no very pronounced change in the position of the heart after the removal of the ribs. The operation in this case was performed under anæsthesia with nitrous oxide because this child did not seem to be a good subject for local anæsthesia on account of her great fear of the operation. The operation was well tolerated and it did not disturb the patient appreciably. She was discharged from the hospital on February 19. The subjective improvement in this patient was as great as in the other patient. In addition a striking objective result was obtained. The venous pressure which had been found by Doctor Irvine-Jones to be eighteen centimetres of water just before the operation could not be measured at the time of discharge, in other words this seemed to be very definite evidence that pressure had been removed at least from the large venous trunks. The mother has been greatly pleased with the results of the operation, particularly with reference to the greater ability of the patient to sleep because of the absence of the complaint of too violent pounding in the precordium. The

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mother also states that for the first time in more than a year the child is able to sleep without a pillow under her head. The nodal rhythm had also disappeared at the time of discharge.

Both of the two cases obtained marked subjective improvement from the operation. The second case, in addition, apparently obtained very definite objective improvement as shown by the disappearance of the raised venous pressure and of the nodal rhythm. In neither case were the ordinary indications for the Brauer

operation of cardiolysis present, such as positive evidence of a tethering of the heart by adhesions. For this reason, therefore, the beneficial results seem to have been due entirely to the effect of a decompression. The return of a decompensation in the first case was of course disappointing, but too much cannot be expected as a result of the operation. For after all one cannot provide a new heart. Despite the recurrence of his broken compensation this fourteen-year-old boy has steadfastly claimed that he feels much better than before the operation and that he regards the operation as having been distinctly worth while. The second patient has remained entirely compensated since the operation, now about three months. During this time also she has been much more active at home than would have been considered advisable.

In reporting these two cases in which a deliberate attempt was made to decompress a large heart it is fully realized that one must be cautious in the evaluation of the results, in fact that, perhaps, it would be unwise to draw any conclusions in the brief time which has elapsed since the operations except that certain striking immediate effects were produced. The operation itself seems to be associated with practically no danger. There would probably be at the most only a few cases in which the procedure would be justified. Those



FIG. 4—X ray of chest about six weeks after operation and again after a swallow of barium. Although the oesophagus is still deviated to the right the amount of deviation is less than before operation. It would seem, therefore, as if the simple decompression relieved somewhat the pressure of the heart on the oesophagus.

apparently would be for the most part children who had a definite precordial bulging with a large heart. Perhaps when more is learned about the effects of pressure on the heart, other cases in which the indications mentioned above may not be present may be regarded as suitable for decompression, on the other hand, perhaps the operation will be found to be of no special value.

NOTE—It is unfortunate that after the presentation of this paper both of these patients described above died.

In the first case the fourteen-year-old boy, as noted in the article above, was readmitted to the hospital five months after the operation because of another attack of cardiac decompensation with evidence of a pulmonary infarct. Death occurred on the evening of April 23. The post-mortem examination performed immediately afterward showed extensive œdema of the lower extremities, the scrotum and the forearms. When the thoracic cavity was opened both pleural spaces were found obliterated in their lower portions by dense fibrous adhesions. There was also some evidence of a more recent pleurisy in process of becoming organized. Pocketed among these various adhesions were small fluid accumulations. The pericardial cavity was entirely obliterated by dense fibrous adhesions which bound the two pericardial surfaces very firmly together. The heart was tremendously enlarged and the chambers markedly



FIG 5—Photograph of patient about two months after operation. The marked anterior bulging of the heart is noticed.

dilated. The adherent pericardium was attached to the anterior thoracic wall and the apex of the heart was pointed in the region of the resected ribs. The mitral valve was greatly thickened and scarred and its leaflets shortened and contracted. The free margins were thick, tough and inelastic. The leaf on the right side of the valve was especially eroded and contracted until only a thin shelf of the original valve leaflet remained. The chordæ tendineæ were greatly thickened, somewhat shortened and were inserted immediately into the free margin of the valve. Distributed along the edge of this valve and extending for some distance down on the chordæ tendineæ were small raised wart-like vegetations characteristic of rheumatic verrucæ. The wall of the left auricle above the mitral valve was scarred and in some places calcium had been deposited in these accumulations of fibrous tissue. The tricuspid valve showed chronic changes but to a less degree than the mitral valve. However, on this valve were

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small verruccæ The aortic valve showed no changes and seemed competent The pulmonic valve also showed no change In the myocardium were small, fine, grayish lines running along the muscle bundles, presumably deposits of connective tissue The coronary vessels seemed normal, the lungs showed an extensive œdema In the lower lobe and in the right upper lobe there was a large red infarct, in the right lower lobe there was apparently an older lesion of some type which was gray instead of red There were some old caseous and partly calcified tracheobronchial lymph nodes The liver was enlarged, weighing 1460 grams It showed passive congestion and œdema

In view of the post-mortem findings in this case it is doubtful if any operation could have had much permanent benefit It is possible, however, that the patient might have been more greatly improved if an extensive removal of the pericardium had been undertaken in order to accomplish a decortication of the heart

The second patient, the girl five years of age, was readmitted to the Children's Hospital April 18, with signs of consolidation of the right lower lobe, fever of 103 and 104, pulse of 160 The heart sounds were the same as on previous admissions No pleural or pericardial friction rub was heard A diagnosis was made of right lower lobe pneumonia There was no evidence of cardiac decompensation and the venous pressure which had been markedly elevated before the operation was not sufficiently elevated to permit measurement at the time of this last admission The child was placed in an oxygen tent but no improvement resulted and she died on April 23 At the post-mortem examination a few fibrous adhesions were found between the parietal pericardium and the chest wall at the site of the operation The heart was much enlarged and the apex extended below the base of both lungs for a distance of three or four centimetres On opening the pericardial sac the pericardium was seen to be smooth and glistening with no adhesions between the two surfaces There was present the usual amount of pericardial fluid The heart weighed 220 grams, its measurements were as follows

Mitral valve	80 cm in circumference
Tricuspid valve	90 cm in circumference
Aortic valve	40 cm in circumference
Thickness of left ventricle	12 cm
Thickness of right ventricle	05 cm

Over the left cardiac surface there were a number of irregular fibrinous plaques The myocardium was of a uniform red color, the musculature appeared normal The mitral valve was markedly thickened at its margin by fibrous tissue The papillary muscles of the mitral valve were much hypertrophied and the chordæ tendineæ were shorter than normal The aortic valve appeared normal as did also the pulmonary valve The margin of the tricuspid valves was moderately thickened, no fresh lesions of endocarditis could be found The coronary arteries were patent and the aorta seemed normal Both lungs showed large areas of consolidation The pleural surfaces over these areas were covered with a thin fibrinous exudate Purulent exudate was squeezed from the bronchi There was no evidence of cardiac decompensation in any of the organs examined

In this case the principal lesion at the time of operation seemed to be a very large heart with an old disease of the mitral valve Very marked immediate benefit apparently resulted from the simple procedure of decompression This benefit apparently was maintained and the death seemed to be an accidental one from an acute infection of the lungs which had no bearing on the cardiac condition so far as could be judged by the post-mortem examination In spite of the death of this patient three months after the operation there seems to me to be a sufficiently beneficial result as to justify the performance of the operation in this sort of a case

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DISCUSSION

DR GEORGE P MULLER said that he had had no personal experience and in the time he had to look up the subject, he could find nothing which suggested decompression of the heart within the limits laid down in the paper of Doctor Graham The writer had excluded the Brauer operation for adhesions within the pericardial sac, indicating that in that disease the liability results from the drawing of the adhesions upon the surrounding structures and that by removing the anterior chest wall one releases the pull Three years ago in reading and abstracting a paper by Dr John H Musser, he noted that of 1700 autopsies 4 per cent died either directly or contributarily from pericarditis with adhesions He wondered whether there are not more indications for the Brauer operation In the American literature there are but few cases reported Shipley's paper on suppurative pericarditis showed that nearly 10 per cent had symptoms referable to the adhesions, and mediastinopericarditis after rheumatism is not uncommon This paper represents something perhaps only an item, but something in the development of thoracic surgery Unless one has kept in touch with the literature of thoracic surgery, one can have no idea how it has developed, and, leaving the tribute to the last, the speaker stated that Doctor Graham has been the chief leader

DR EDWARD ARCHIBALD said that he remembered very well reviewing the first article of Brauer, in 1903, for a local medical journal and of being intensely interested in it He has been talking to medical men on occasion for years, and asking them if they did not think that certain of their heart cases should have a cardiolyse He never found a medical man until the last year or so, who was willing to look at the question at all from a possible surgical point of view However, lately in his clinic he has had a young man who has acquired a certain authority and whose mind is open and with him The speaker has seen two patients in the last year concerning whom they deliberated whether an operation should be undertaken In one case they decided they might do it, but their intention was frustrated by an attack

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of such serious decompensation complicated by infection, that it became impossible to operate and the patient died not long afterward. In the other they were afraid to operate because of the fact that they did not have the Brauer picture of adhesive pericarditis and mediastinitis. Doctor Archibald was pleased to hear Doctor Graham tell of his two cases, the second one of which was so encouraging, and to learn that the presence of the original picture had not been found necessary for the success of surgical interference.

From his experience in thoracoplasty, particularly in pulmonary tuberculosis, he has learned to respect the heart with the coincidence of a fibrotic lung, it is not safe to uncover it too much. In serious fibrotic cases with great contraction on the left side, the heart may be pulled up so far laterally and posteriorly that a portion of it may be exposed by posterior rib removal, whereby a certain risk is run, in the sense that the heart's action is made more rapid. It is difficult to say whether this result is due to the loss of the support which the heart gradually acquires in its new position from fibrotic contraction, and doubtless there are other factors which enter in, as for instance the tuberculosis. But the speaker has not been able to escape the impression that the uncovering of the heart does contribute to a relative heart failure, he is not able to reconcile these observations, if true, with the good effect obtained by cardiolysis in a condition which is also contractile, indeed he must confess that, in spite of a good deal of reading, he does not yet see his way at all clear in the matter of the indications for cardiolysis. He feels nevertheless, that Doctor Graham's contribution is a valuable addition to the subject, and hopes for the opportunity to study his cases more carefully.

DR EVARTS A GRAHAM wished to emphasize one or two things. First of all, that he does not claim any originality for the idea of decompression of the heart. Alexander Morrison, of Edinburgh, in 1907, had in view the same idea which Doctor Graham expressed in this paper.

Regarding Doctor Archibald's remarks, if the speaker understood him correctly, he thinks that after thoracoplasty in cases of unilateral tuberculosis cardiac failure occurs because the heart has been freed from its fibrotic surroundings or rib support. Doctor Graham thinks this is a matter of interpretation and is inclined to disagree with him in his interpretation. In Alexander's survey of the literature on thoracoplasty, of 1100 cases nearly all of the deaths occurring within the first week or so after operation were due to pulmonary oedema. It appears that the most common cause of operative death in thoracoplasty is compression, whether of the big veins or of the heart he does not know, but it is compression of a sort we should not get. The fibrous capsule might act as a protection against pressure just as against depression, in the speaker's opinion both effects after thoracoplasty are due to too much pressure and not to the relief of pressure.

He was greatly impressed by what Doctor Muller had to say, namely, there must be literally hundreds of cases even of chronic pericarditis suffering from cardiac decompensation which could be greatly relieved by this simple

form of cardiolysis This speaker had the opportunity to operate on one such patient, a man who had been totally incapacitated for several months, and who since operation has not missed a single day of work, working ten hours a day, it has been four and one-half years since operation Answering Doctor Gibbon's question as to the operation described by Doctor Summers, the original operation as first described by Brauer, was for opening the pericardium and separating adhesions, he now advocates merely removal of the ribs and chest wall in order to permit the heart to pull on yielding structures and not on non-yielding ones Doctor Summers' operation was of the latter type Dr Elsworth Smith, of St Louis, has recently reviewed the entire literature on cardiolysis and he has found seventy-two cases in the literature of the entire world in which cases of chronic pericarditis had been operated on by this method

Another point probably not made clear is the one which Doctor Archibald mentioned, many cases which could have been benefited by this procedure have been refused the operation because they did not present the clinical picture and were thought therefore not to be amenable to this simple performance of cardiolysis From the speaker's experience with these two cases, he does not think we need to find a very definite clinical syndrome of chronic adhesive pericarditis in order to give relief by this operation

THE DEVELOPMENT OF SURGERY OF THE STOMACH

WITH SPECIAL REFERENCE TO THE PART PLAYED BY AMERICAN SURGEONS^{*}

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HISTORICAL studies, always of interest, are profitable in proportion to the open-mindedness of the student. Thus only may he really benefit by the lessons contained therein. The historical approach to the study of any subject is most helpful. To learn what others have thought and done, along this or kindred lines, is both helpful and illuminating, as well as saving of valuable time and effort in covering ground that may have been already explored. This fact is well illustrated in tracing the development of surgery of the stomach from the crudeness of the first gastrotomy, as performed by Oriental surgeons, to the fineness of the total resection of that organ as performed today in one of our modern clinics.

In casting about for a subject for my address this afternoon, it has seemed to me that we could, perhaps, spend the time as profitably in this way as in any other. Unfortunately, however, the field is so broad that, in the limited time at our disposal, we cannot attempt to do more than touch the high places. What we shall have to say must, of necessity, therefore, be sketchy in the extreme. In the preparation of this brief historical review, we have been both interested and gratified in tracing the important part played by American surgeons in the development of surgery of the stomach. As Americans, we may well be proud of the contributions made to this branch of surgery by our fellow countrymen.

Philadelphians will, I am sure, be quick to claim the credit due for the pioneer work done by the great surgeons, past and present, whose names have added lustre both to their fair city and to the medical profession.

References to surgical procedures upon the gastro-intestinal tract by early medical historians are meagre. Hippocrates, Aphorism No 18, states, "a severe wound of the bladder, of the brain, of the heart, of the small intestine, of the stomach and of the liver is deadly." While this statement clearly shows that even at this early date, along with wounds of certain other viscera, wounds of the stomach were already differentiated and their seriousness recognized, yet we have no definite knowledge as to how they were treated. Galen, in commenting upon this Aphorism, makes the statement that "it is said that some wounds of the stomach have been observed to heal, though seldom indeed."

Celsus refers to the use of the suture in wounds of the large intestine, but does not mention its use in either the small intestine or stomach, probably

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simply an oversight Fallopius recommends for use in suturing wounds of the stomach linen or silk thread, and the continuous suture Ambrose Pare, among others, also refers in his writings to intestinal suture It thus appears that suture of the hollow viscera, even at a very early date, was a recognized surgical procedure From the absence of any direct evidence to the contrary, it is quite probable that the wounds of the stomach, for which suture was recommended, were of traumatic origin rather than those purposefully inflicted by the surgeon

The earliest definite references to surgical operations upon the stomach that I have been able to find are contained in "La Grande Chirurgie," by Guy de Chauliac, written in 1363 He writes as if the operation of suture of the stomach were already a recognized procedure The following quotation would seem to justify this assumption "In a penetrating wound of the abdomen in which the internal parts are wounded and do not protrude, if the said wound suffices, or, if it does not suffice, it may be extended with a suitable instrument, to be described later they, *i e* the wounded internal parts, may be discreetly drawn outside And if they are in need of suture, and if it profits them, as in wounds of the fundus of the stomach and large bowels, they may be sutured with the glover's suture, and not with the heads of ants, as recommended by some experimenters" With reference to the latter interesting and somewhat novel method of suturing the stomach walls, Gurlt, quoting from Leclerc's translation of Albucassis' "Surgery," written about the beginning of the tenth century, has this to say "Ants with large heads are used, the edges of the wound are united and the head of the ant applied with the mouth open, to the lips of the wound As soon as the ant has closed its mouth by closing the mandibles, the head is cut off and remains permanently attached Others are applied, according to the extent of the wound The wound is then reduced and a suture is applied to it Now these heads remain adherent to the intestine until it has healed without causing any inconvenience to the patient" He goes on further to say "The intestines can also be sutured by means of small filaments which are detached from the intestines of animals, on which they are superimposed They are threaded in the needle in the following fashion one of these filaments is seized and is disengaged with care, it is knotted with the end of a linen thread, fine and twisted, with which a needle is armed and the intestine sewed up"

In this single paragraph, reference is made to the early, perhaps, the earliest, beginnings of three important technical procedures in surgery, namely, the heads of ants, a forerunner of metallic clips, absorbable animal tissue as a suture material, from which comes catgut, kangaroo tendon, facial strips, etc., the silk or linen guide, so widely used, especially by the early gynecologists for the easier introduction of the larger sizes of catgut then in vogue

The first reference to a definitely planned operation, other than the suture of an accidental wound, that I have been able to find is that reported by Gunther in his classical work on surgery He quotes Crollius, who reports

the case of a peasant, thirty-six years old, who practiced jugglery and was in the habit of concealing a horn-handled knife in his throat. In the course of such a manœuvre, the knife slipped down into his stomach and remained there for seven weeks. After plasters and other means of treatment had been employed (among them a magnet to the stomach region) the point of the knife began to cut its way through the abdominal wall. At his urgent request, Mathis made an incision and extracted the knife. The date of this operation was 1602. The knife was nine inches long, entirely rusted, and was said to have been preserved as a curiosity. The patient recovered. Numerous references to this case, which appears to have been quite celebrated, are to be found in the literature.

Again, in 1743, in the *Memoirs of the Royal Academy*, is to be found the report of a woman who, wishing to induce vomiting, inserted the handle of a knife into her throat. The knife, about seven inches long, slipped from her grasp and entered the stomach. After three days, she began to feel pain. On the eleventh day, the surgeon made an incision in the left hypochondrium, where the point had pierced the abdominal wall, and removed it.

Baïon Larrey, in his *Memoirs*, reports that while a student at Toulouse in 1780, he was present when Doctor Frizac removed a piece of knifeblade from the stomach of a man. The patient recovered.

Other similar cases are to be found scattered through the literature, in fact the early history of surgery of the stomach seems to be confined to the relation of cases of suture of accidental wounds or the removal of foreign bodies, principally knives. The surprising thing about it all is the large percentage of recoveries among the cases reported. Can it be true of ancient, as well as of modern surgery, that the successful cases seem, somehow, to find their way into the literature with greater facility than the unsuccessful ones?

Apparently, the first American operation upon the stomach, the suture of a stab-wound of that organ, is recorded by John Archer, *Medical Repository*, New York, 1812. This case is one of considerable interest, for several reasons. (1) It was reported by John Archer, of Harford County, Maryland, who was the first to receive a medical degree in this country. He was graduated from Princeton College with the degree of A.B. in 1760, and was a member of the first class to graduate in medicine from the Philadelphia Medical College, the forerunner of the University of Pennsylvania, in 1768.

In the year 1837, Egeberg, a Norwegian Army surgeon, in a lecture before the Medical Society of Christiania, first recommended, as a justifiable procedure, the establishment of a permanent fistulous opening in the stomach through the abdominal wall, to which operative procedure the name of "gastrostomy" was given nine years later. The idea of establishing a fistulous opening into the stomach was suggested to him while studying a case of carcinomatous constriction of the œsophagus which had resisted all the usual forms of treatment. In justification of his position, he quotes cases in which individuals had sustained traumatic fistulæ of the stomach for varying terms

of years, without especial trouble. He referred particularly to the epoch-making case of Alexis St Martin, studied by Beaumont and reported by him in 1826.

Egeberg (1837), in discussing the subject of treatment of inoperable stricture of the œsophagus, asks the significant question, "Can nothing be done except feeding by rectum for such a case?" He suggests œsophagotomy for strictures high up, and gastrotomy for strictures low down. In discussing this latter proposition, he enunciates the principle, just as true today as then, namely, "that the permissibility or non-permissibility of an operation depends upon the degree of sound probability that the operation will bring the desired result." He calls attention to the fact that hitherto the operation had been done only in order to remove foreign bodies. He recommends preliminary suture of the parietal and visceral peritoneal surfaces, in order to form protecting adhesions and prevent extravasation. "I cannot see why," he adds, "the indications should not be just as great to open the intestinal canal to put nourishment in as it is to open it to take a foreign body out." His logic is as convincing as his judgment was sound. He concludes his thesis by saying, "It all goes to prove that the stomach is not a *noli me tangere*."

In 1846, Sedillot reported to the French Academy of Sciences the results of some operative experiments that he had made upon dogs. For this procedure, he first suggested the name of "*gastrotomie fistuleuse*." He reported three dogs upon which he had performed this operation with complete success. In a later communication he reported more in detail upon the same subject, discussing the indications for and against the operation, and proposes the name "gastrostomy," which has since been generally accepted by the profession.

Again in 1849 the same author reported the first case of gastrostomy deliberately planned and performed upon a human being. This patient, unfortunately, died a short time after the operation. Nothing daunted, four years later, he again operated in a similar manner, with the same result. Nevertheless, he predicted that "gastrostomy," in properly selected cases, is destined to enter definitely into the domain of practical surgery, a prophecy long since abundantly verified.

Fenger, of Copenhagen, was the second surgeon to perform this operation in 1853 independently of Sedillot, and after extended experiments upon animals.

In view of the continued agitation by misguided and fanatical antivivisectionists, it is interesting, indeed impressive, to note the early important part played in the development of surgery of the stomach by animal experimentation. Again and again, in reading over the reports of the work of the pioneers in gastro-intestinal surgery, one finds records of preliminary operations upon animals, indicating that many of the advances were based upon scientific experimentation and not the result of mere haphazard chance. Zesas, in his monumental work, calls attention to the fact that this period of the early forties was quite fruitful in experimental research along these

lines He refers to gastrostomies performed upon animals by Blondlot, Bassow, Baideleben and other surgeons

In this country, Watson, of New York, in 1844, discussed the question of the practicability of gastrostomy "Having now shown," says Watson, "that wounds of the stomach are far from being necessarily fatal, we may next proceed to show that openings, whether the result of injury or occurring spontaneously, may give rise to permanent fistulous communication between the stomach and external surface of the abdomen, and that such fistulæ may exist for years without seriously interfering with digestion or impairing the general health" In the face of these facts, he unhesitatingly recommended gastrostomy with the view of prolonging life in cases of intractable constrictions of the œsophagus

The first gastrostomy performed upon man by an American surgeon of which I can find record was by Maury, of Philadelphia, in 1869, (*American Journal of the Medical Sciences*, vol. lix, 1870) It was deliberately planned and undertaken for relief of stricture of the œsophagus, after consultation with the Elders Gross, Pepper, and Weir Mitchell Notwithstanding the usual fatal result, Maury states emphatically, "so great is my conviction that the procedure is justifiable, and to be regarded as one of the established operations of surgery, that I would have no hesitation in resorting to it in any case of impending starvation from non-cancerous stricture of the œsophagus, provided malnutrition had not reached a stage which rendered the case hopeless, and, I may state, that Doctors Gross, Pepper and Weir Mitchell entertain similar views" Certainly high commendation for any surgical procedure! While, therefore, credit is due to Egeberg, for first suggesting, and to Sédillot, for first performing this particular procedure, they must share with Fenger, Watson and others the credit for having first tested it experimentally and having established it upon a firm scientific basis

Due recognition should here be given to the epoch-making work of William Beaumont, an army surgeon, the pioneer American physiologist, and to the value of his experimental studies in digestion made in 1822 and first published in 1826, upon the celebrated case of Alexis St Martin, the French Canadian, to which reference has already been made Says Sir William Osler "There had been several cases of artificial gastric fistula in man which had been made the subject of experimental studies, but the case of St Martin stands out from all others on account of the ability and care with which the experiments were conducted" And he, in turn, quotes Combe, as follows "The value of these experiments consists partly in the admirable opportunities for observation which Beaumont enjoyed, and partly in the candid and truth-seeking spirit in which his inquiries seem to have been conducted" This work of Beaumont has been the model for all of his followers, antedating, as it does, the epoch-making work of Pawlow, and reflects great credit upon American medicine All honor to this pioneer American scientist!

In 1810, Merrem, of Giessen, in an interesting monograph, reported

some experiments upon dogs, undertaken in order to determine whether or not extirpation of the pylorus was possible

It would appear from Merrem's statements that his work in this direction had been stimulated by the report of the experience, to use his own words, of a "certain famous professor, highly respected and renowned among the medical profession in Philadelphia" Unfortunately, Merrem neglects to give the name of this renowned Philadelphia professor, and a diligent search of all available sources fails, so far, to reveal either his identity or the source from which Merrem obtained his information This is extremely unfortunate, as, apparently, his work on the resection of the pylorus in dogs, done in 1779, antedates by about a century any similar work of which record can be found To this unknown Philadelphia professor must be given credit, therefore, as the pioneer in this line of work

Merrem's observation upon the future of pylorotomy based upon his own experimental work, which is reported in full, is of sufficient interest to quote "That the extirpation of the pylorus can be accomplished with happy results seems to be confirmed by these experiments, nevertheless, experience has shown that it is a very difficult operation"

Reviewing these experiments of Merrem many years later, Langenbeck comments as follows "To me it is inconceivable that anyone could think of extirpating the pylorus in man, so that it is not necessary to give reasons why this operation can never succeed" He then gives six specific reasons why it cannot possibly succeed, and ends with this significant comment "I look upon this operation as a quicker method of sending out of this world a man whom it is impossible to save" An instance, of which the history of medicine contains other notable examples, where a celebrated personage has failed to grasp the full significance of the signs of the times

Billroth was a better prophet, although he had the advantage of a later date for his prophecy In 1877, he reported the operation performed by him in June of that year, which he called by the name of "gastrorrhaphie" This operation was performed for the closure of a gastric fistula which had resisted all other attempts at healing Briefly, the operation was the separation of the stomach from the parietal peritoneum, to which it was densely adherent, next, the turning in of the edges of the stomach wound, which were sutured with fine silk, after inverting the edges of the gastric fistula

In discussing this case, Billroth makes this significant comment "This rare case should serve as a model for similar cases, and for many additional procedures along the same lines From this operation to the resection of a piece of carcinomatous stomach, there is only a bold step to be taken, just as Czerny lately took the step from œsophagotomy to resection of a carcinomatous piece of œsophagus" It is here the influence of the Billroth School first began to make itself felt in stomach surgery

It is interesting to note that preliminary experimental work, with this end in view, had already been done in Billroth's clinic by his assistants, Gussenbauer and v Winwarter Their work, published a year previously, refers

especially to the possibility of the operative treatment of cancer of the stomach, and dealt primarily with resection of the pyloric portion. They give detailed accounts of their experimental operations upon seven dogs, only two of which survived the immediate effects of the operation. The chief cause of failure seems to have been sepsis. Their work, however, established the fact that such an operation was possible under favorable conditions, and with better asepsis. To quote their own words: "The experiments here reported prove sufficiently that partial resection of the stomach, in so far as its practicability is concerned, does not involve undue difficulties, and the failures are due more to the accompanying circumstances than to the wound as such. On the basis of the experiments herewith reported, we believe that we are justified in proposing to employ partial resection of the stomach in man for the removal of carcinoma of the stomach, which experience has shown is most frequently located at the pylorus." Brave words, these, and advanced for that period, breathing, as they do, the scientific imagination, tinctured with the enthusiasm of youth.

At the same time, 1876, Czerny and Kaiser were following a similar line of experimental work upon resection of portions of the stomach in dogs, and succeeded in resecting the entire stomach of a dog, which survived and flourished for five years, his digestion and nutrition seemingly in no way impaired. He was then killed and his stomach examined by Ludwig, the physiologist, who found that a small piece of stomach wall at the cardiac end had been left, which had become dilated, forming a spherical pouch, which was filled with food.

The first resection operation upon the stomach in man was performed in 1879, by no less a person than Péan, the great French surgeon, who did a pyloric resection in an advanced case of cancer of the pylorus. The patient, very weak and emaciated from a practically complete obstruction of some weeks' duration, survived for five days. Péan, in discussing the operation, emphasized the feasibility of pyloric resection as a justifiable procedure, expressing the opinion that such would eventually be found to be the case.

A year later, 1880, Rydiger, influenced, as he states, by the experimental work on animals of Gussenbauer and v. Winwarther from Billroth's clinic, and that of Wehr, one of his own assistants, and by Péan's case just referred to, performed the second pyloric resection in man. Rydiger's operation did not differ materially from that of Péan, except that he used catgut throughout instead of silk, and he excised a triangular portion of the lesser curvature of the stomach, which defect was closed by an oblique line of sutures, thus lessening the lumen of the stomach to more nearly that of the duodenum. Péan had made a transverse resection of the stomach, and had inserted the duodenum into the lower angle of the stomach incision. This was done in accordance with Wehr's experimental work. The autopsy showed that, macroscopically, the cancer had been entirely removed, and, there were no signs of infection. It was supposed that the case had died of inanition. In discussing his operation, Rydiger comments as follows: "In reviewing

this case, we believe that we are justified in saying that this operation (pyloric resection) certainly has a future. We must not be frightened off by the first failures. First of all, we shall have to discover the earlier stages of cancer of the pylorus, and, for this end, greater certainty in the diagnosis of the very first stages is greatly to be desired. But then there is still much to be done to build up a good and certain technic of operation." "We agree," he goes on to say, "entirely with Czerny, that no one should attempt this operation who has not previously acquired the necessary practice by experiments on the cadaver and on living animals." Wise surgeons, were they not? Many of the principles enunciated by them are just as true today as then, and departure from them is sure to court disaster.

One year later, in 1881, Billroth reported the first successful case of pyloric resection, the third performed on man, also for cancer of the pylorus. In his comments upon the operation, Billroth further establishes his reputation as a true prophet, as well as a master surgeon. "To reassure those who are of the opinion that my present operation is a foolhardy experiment on man is beside the question. Resection of the stomach has been as completely worked up anatomically, physiologically and technically by my students and myself as any other new operation. Every surgeon, who has had experience in experiments on animals and similar operations on man, has reached the conviction that resection of the stomach must and will succeed. To establish the indications and contraindications, and to work out the technic for the widely different cases, must be our next concern, and the object of our further studies."

The name of "Billroth" is inseparably connected with resections of the stomach and pylorus. The two operations that bear his name, Billroth Methods No. 1 and No. 2, or some modifications of them, represent the two types of resection operation generally performed upon the stomach. With these two classical procedures, everyone is, of course, quite familiar, so description of them will be omitted. There are, however, certain difficulties inherent in both procedures that will be at once apparent to the experienced abdominal surgeon. Recognizing these technical difficulties, many modifications of this operation, of more or less merit, have, from time to time been suggested.

The great name of Kocher is intimately associated with the operative development of this phase of gastric surgery, and the well-known operation devised by him, and which bears his name, has a definite place in surgery.

It would lead us too far afield to discuss the varied and multitudinous modifications of the operation of pylorotomy that have been, from time to time, reported. Suffice it to say that the various methods devised by and bearing the names of Kocher, Mikulicz, Kronlein, Reichel, Polya, Finsterer, v. Haberer, and a host of others, including the speaker, are all of them, in a sense, modifications of one or other of these two methods of Billroth.

To Randolph Winslow, of Baltimore, belongs the credit for having been

the first American surgeon to attempt a pylorotomy. He resected the pylorus for a case of cancer of the stomach in 1884 (*American Journal of the Medical Sciences*, July, 1884). Unfortunately, the patient survived the operation but a few hours.

Pylorotomy antedated gastro-enterostomy by two years, but the latter, as it has been gradually developed, has largely superseded the former, until it has, perhaps, become the most popular operation upon the stomach.

The name "gastro-enterostomy" was suggested by Wolfer, at that time an assistant in Billroth's clinic, for a procedure first employed in 1881, and reported by him in that year in the *Centralblatt für Chirurgie*.

The operation was performed on a patient suffering from advanced carcinoma of the pylorus. A loop of jejunum was attached to the anterior wall of the stomach. The result of the operation was quite satisfactory. The second case was operated upon by Billroth himself in the same way. This patient developed a persistent bilious vomiting, from which the patient died on the tenth day. The autopsy showed the interesting condition so well known in the earlier days of the operation under the terms of "spur formation," or "vicious circle."

To Ransohoff, of Cincinnati, belongs the credit of being the first American surgeon to perform this operation. His case, carcinoma of the pylorus, was reported in the *Medical News*, November, 1884, and, unfortunately, succumbed in a few hours.

Many modifications of the operation of gastro-enterostomy have been suggested from time to time since Wolfer's original publication, the most important of which, perhaps, is v. Hacker's retrogastric method reported in 1885. The credit for the idea of making the anastomosis on the posterior, instead of the anterior, wall of the stomach has generally been given to v. Hacker. Courvoisier, however, antedated v. Hacker's work by two years, having reported in 1883 a case that he had operated upon in that way. The patient died thirteen days later of a diffuse peritonitis. In discussing the operation, he calls attention to the advisability of identifying the loop of jejunum used for the anastomosis by first finding the duodenojejunal angle, thus avoiding the use of a haphazard loop, a very real and important advance. In anastomosing the loop of jejunum to the posterior wall of the stomach, he made his incision in the mesocolon parallel to the long axis of the colon, rather than parallel to the blood supply, as did v. Hacker later. His patient, too, unfortunately, died, a record that recurs with melancholy frequency among the pioneer cases of gastric surgery. He was the first to suture the edges of the rent in the mesocolon to the stomach wall, another distinct addition to the technic of the operation. In discussing the high mortality rate of this operation, he makes this pertinent comment: "This is easily understood, since inoperable carcinoma is generally the indication for the operation."

Because of the fact that it is such a comparatively simple procedure,

gastrojejunostomy has been at times employed rather indiscriminately and without proper indications

The operation of gastro-enterostomy, whether performed anteriorly by the original long loop, either with or without some form of supplementary entero-anastomosis, or by the posterior no-loop-gastro-enterostomy, presents certain obvious objections inherent to the method. These are well known to every surgeon of experience, and are responsible for approximately 20 per cent of unsatisfactory results. A few clinics report a lower percentage of failures, but the average is about as stated.

In order to do away, as far as possible, with these objections, various methods of direct union of the stomach and duodenum have been suggested and practiced by different authors.

To Jaboulay belongs the credit for having, in 1892, first suggested the method of gastroduodenostomy, which he, two years later, performed. He made the anastomosis directly between the walls of the duodenum and the stomach, folding the duodenum over on the anterior wall of the stomach, using the pylorus as a hinge.

Shortly after, Kummel reported an almost identical procedure. Later Villard, in 1897, brought the duodenum and stomach together side by side, and anastomosed the duodenum to the greater curvature of the stomach in what he calls his "subpyloric gastroduodenostomy." In this method, he does not disturb the pylorus at all.

In his original article, Jaboulay directs attention to the prime necessity of mobilization of the duodenum in all operations that have to do with the utilization of this portion of the intestinal canal for anastomotic purposes. Kocher, later, again stressed this point, and my own experience in this particular field has abundantly confirmed his observations. I wish to reemphasize this point, namely, that upon the surgeon's ability to mobilize satisfactorily the duodenum depends, in large measure, the success of all forms of gastroduodenostomy.

Following Jaboulay's lead, many variations of his operation, of more or less merit, have been suggested.

In discussing gastroduodenostomy (pyloroplasty) and its indications and contraindications, Kocher makes the following emphatic statement, which expresses our own conviction in the matter: "Unlike other surgeons who have performed gastroduodenostomy, we do not limit the operation to special cases. On the contrary, we regard it as the normal procedure over all the previous methods,"—certainly high praise from one of the greatest of surgeons.

We have come to this way of thinking because we have found that, after thorough mobilization of the duodenum, one can do almost anything that he wishes with it, excise ulcers situated on either side of the pylorus, in fact, do a virtual pylorectomy through the gastroduodenostomy incision, as first suggested by us many years ago.

Gastrectomy has, from the beginning, held a great deal of interest for American surgeons. The first to perform this formidable operation was

Conner, of Cincinnati, in 1884, and, of the first dozen gastrectomies performed, six were by American surgeons. In discussing his case, which, unfortunately, died upon the table from shock, Conner says "I had hoped to be able to get the cardia attached to some portion of the intestinal tract. I did not care much where, so that the fluids poured out into the upper part of the small intestine might flow down to meet the food and cause digestion in that part of the intestine where they came together." He further states that he considered the operation a perfectly feasible procedure.

The first successful total gastrectomy was reported by Schlatter, of Zurich, in 1897. The second successful case was operated upon by Brigham, of San Francisco, in May, 1898.

In a recent monograph published jointly by the speaker and Rienhoff, sixty-seven cases of undoubted total gastrectomy were reported, with thirty-one recoveries, fifty-five cases of subtotal gastrectomy, with forty-one recoveries,—a truly remarkable showing!

In 1910, Payr, of Leipsic, recommended the so-called "sleeve resection," which, as the name indicates, involved the removal of a zone of tissue from the body of the stomach. This method achieved a considerable degree of popularity for a time, chiefly in Germany, but, owing to certain obvious objections, it never came into general use.

Experience has shown that in the "V"-shaped type of resection, the mechanical function of the stomach is more or less seriously interfered with, and emptying of its contents delayed. This, of course, constitutes a serious objection to its extended use.

With regard to the excision of ulcers, as first performed by Rydiger, 1881, other things being equal, it would appear to be advantageous to attack the ulcer directly and extirpate it completely, because there are certain possibilities for serious trouble inherent in an ulcer, namely, perforation, hæmorrhage, deformity from perigastric adhesions, narrowing of the lumen by cicatricial contraction and, lastly, in the malignant degeneration, which, in gastric ulcer is a real possibility. On the other hand, the resection of any considerable portion of the wall of the viscus must necessarily be attended by a certain amount of deformity and interference with function. These factors must all be taken into consideration in deciding for or against resection. It must be borne in mind, too, that even after complete resection of an ulcer, recurrence has been known to take place. Giving due weight to all these considerations, however, the manifest advantages occurring from excision of the ulcer would seem to warrant giving the operation serious consideration where practicable. Some operators make a practice of combining gastro-enterostomy with excision of the ulcer, but this would appear to be unnecessary, except where there is present definite obstruction of the pylorus. Our own practice has always been to excise the ulcer where possible, whether gastric or duodenal, through the gastroduodenal incision, recommended by us over twenty years ago, or to resect the pyloric portion of the stomach in case of gastric ulcer along the lesser curvature, followed by a gastroduo-

denostomy end-to-side, the so-called "Haberer-Finney Method," or by a gastrojejunostomy, after the method of Polya

Of late, a tendency has been observed, especially in some of the Continental clinics, and in a few in this country, toward massive resection of the stomach in the treatment of duodenal and gastric ulcer. This is but an elaboration of Rodman's idea, enunciated many years ago, of the excision of the so-called "ulcer-bearing area." Unquestionably in certain cases of the indurated type of ulcer, where both the operating surgeon and the pathologist find difficulty in distinguishing it from cancer, wide excision is to be recommended. In fact, when in doubt, it is probably the safer course, in all cases, to practice resection rather than any less radical method. But sane surgical judgment will, I think, not sanction the indiscriminate use of unnecessarily mutilating operations upon the stomach any more readily than elsewhere in the body. Such extensive resection operations, undoubtedly, have their place in surgery, but their use should be restricted for the present, at any rate, until we know a little more surely the ultimate effect of such extreme measures upon the physiology of digestion.

Time would fail us, nor is it the purpose of this paper, to discuss the many interesting problems in the etiology and pathology of ulcer and cancer of the stomach, or, in chemistry, physics, anatomy and physiology that are involved. Our aim has been rather to give a hasty and necessarily sketchy review of the history of the development of surgery of the stomach, in the hope of gaining a wider knowledge of, and a deeper insight into, the mental processes that controlled the pioneers in surgical thought and progress. Much creditable work has not been referred to, not because of lack of merit, but simply because of lack of time. Only those epoch-making contributions have been considered, which seem to have influenced more or less profoundly the historical development of the subject.

In this study, we have been interested in principles rather than methods. It has been a real pleasure to direct attention to some of the many excellent contributions that have been made by American surgeons, and in giving a somewhat tardy recognition to their pioneer work in this particular field.

It is of interest to note the order of sequence in which the various operative procedures on the stomach have been developed. (1) The emergency operations—suture of accidental wounds of the viscus, removal of dangerous foreign bodies that had been swallowed, *e g*, knives and other sharp-cutting objects. (2) The stage of deliberately planned operations, those of necessity, for the relief of obstructive symptoms resulting from cancerous growths or cicatricial contractions in the œsophagus or at the pylorus, or for the removal of these growths themselves. Then when more confidence had been gained from experimental study and wider knowledge of physiology and pathology, and with better surgical technic, gradually the field of surgical endeavor has been widened to include ulcer and all of the many sequelæ resulting therefrom. In other words, as in most other departments of surgery, the operations of necessity preceded the operations of choice, but once the principles

thus laid down by the pioneer surgeons came to be established, further application and development along different lines were not long delayed

As indicated in the opening sentence of this paper, many useful lessons may be learned from a study of surgical history. Among the more important, perhaps, are, first, in order that a given operation or method of surgical procedure should attain lasting success, it must be based upon correct anatomical, physiological and pathological principles. It must, in addition, conform to certain general laws of practicability and technic, that is, it should be possible of accomplishment with a fair degree of ease, by a surgeon of average skill and ability. Finally, it should yield a high percentage of success, both as regards immediate mortality rate and ultimate functional recovery.

The pages of the history of surgery are covered with the records of operative procedures without number that, like Jonah's gourd, flourished vigorously for a time, but, when the pitiless rays of criticism and experience beat down upon them, like the gourd, they withered, because they were not deeply rooted in the fundamental principles underlying all good surgery. If he would not appear ridiculous, let him, therefore, who would benefit from the lessons of history, before linking his name to a given operative procedure, make sure that it conforms to the above requisites.

Furthermore, it should not be forgotten that all recoveries from surgical operations are not accompanied by complete restoration of function, far from it. It is a sad, and all too frequent, occurrence that a patient may recover from a surgical operation, and not only may be no better, but may even be worse than before. The war has taught us the valuable lesson that the term "recovery" should include function as well as life and that, other things being equal, a recovery from a surgical operation that does not carry with it restoration of function and the ability to enjoy life and earn a living, is hardly worthy of the name.

Applying these historical tests to the many and various surgical procedures that have been brought forward in the past comparatively few fruitful years of the development of gastric surgery, it will be readily seen why so many efforts in this direction were still-born, and why yet others failed to survive early infancy, leaving nothing but their memories behind. Changing the metaphor, they were sown in shallow ground physiologically, pathologically and surgically, and hence quickly withered and died. On the other hand, while there may be an occasional exception to this rule, it will be found that those methods that have stood the test of time and experience and that continue to yield the best functional results, with the lowest mortality rate, are those that most nearly conform to the fundamental principles of good surgery, which, in this presence, it is unnecessary to enumerate.

Let me repeat, in the last analysis, the acid test of every surgical procedure is the ultimate result in terms of restored physiological function and slight immediate risk to the life of the patient. The attainment of this goal should be the constant aim of the surgeon.

Every case that comes to the surgeon presents a problem which should

be studied and decided, upon its own individual merits, and not by a process of generalization or by custom or habit, as is too often the case

The surgeon's problem is twofold, diagnosis and treatment. The former may be established only after careful, perhaps prolonged, study of the case. The services of a competent internist may here prove most valuable. At times a positive diagnosis may not be possible without an exploratory incision, and rarely, not even then. After the diagnosis has been made as nearly as may be, it becomes a matter for mature surgical judgment, not routine, nor habit, nor fashion, to decide what is the surgical procedure that is most likely to give the best result in the particular case. Personally, the speaker has long since abandoned the pernicious habit of deciding beforehand what he will do in operating upon a given case, for each should be a law unto itself. In one case, one surgical procedure will be found to adapt itself best to the conditions present, while, in another case, another method will surely yield a better result, and the patient should always be given the benefit of the choice, and that method of operation which most nearly complies with the conditions found, other things being equal, should be given the preference. It is bad judgment and worse surgery to push the use of any operative method beyond its anatomical and physiological limitations. By so doing, the surgeon but courts disaster.

When these fundamental principles of surgery, abundantly established as they have been, both historically and by the combined experience of leading surgeons everywhere, come to be thoroughly understood and more generally observed, much of the present dissatisfaction with the end results of surgery of the stomach, upon the part of both patient and surgeon, will happily disappear.

DISCUSSION

DR J STEWART RODMAN said that since there is nothing to be added from the historical viewpoint it seemed that he might best use the time allotted in an attempt to briefly appraise some of these procedures from the standpoint of their ready usefulness in the clinic of an average worker in one of our larger centres.

The very fact that there is such a wide choice of procedure makes the problem somewhat difficult. It has seemed to the speaker that those of us who, even with several hospital appointments, have clinics of only moderate size will do well to limit the choice of operation to a comparatively few well-tried procedures and to leave to our larger clinics, with their vast array of cases, the broader field. This choice must of necessity, however, include a sufficiently broad field to cover the important necessities for management which arise for any surgeon who is qualified to handle gastric surgery.

In the first place, we are all called upon to handle the acute emergencies and should have a definite plan therefore of handling hæmorrhage, gastric or duodenal, or perforation of the stomach or duodenum. Hæmorrhage will often respond, in fact usually, to medical treatment, and it is essential

to closely cooperate with the medical side in this matter as indeed in all others when undertaking the management of any gastric lesion. Usually rest in bed, morphia, restriction of diet and an ice-cap locally will suffice. If hæmorrhage is repeated the introduction into the stomach through a tube of hot water at 120° will sometimes check the bleeding. It is necessary, of course, that transfusion be done at times but this should be guardedly done as active bleeding may be thus started up. Lastly we will be called on, although infrequently, to directly check the bleeding by operative measures and then there is nothing to do but gastrotomy with direct ligature of the bleeding point. Whether or not gastro-enterostomy should be added to this must be decided by two factors—first, one's ability to find the bleeding point, and second, the condition of the patient and the consequent margin of safety that one is working with in that particular case. Theoretically it is better to do a gastro-enterostomy if possible, especially if the bleeding area be at or near the pylorus.

In dealing with perforations either gastric or duodenal, unless the case be seen very early, say within the first six hours and there has been but small chance for soiling of the peritoneum, the least done in order to save the patient's life the better. Simple closure by purse string of the perforation reinforced by an omental tag, has been the speaker's choice in most cases. In a few cases where the perforation is duodenal and where the patient was seen early, he has been influenced by the teachings of Doctor Deaver who has had such a large experience in gastric surgery, and done a gastro-enterostomy as well. Undoubtedly there are times when ulcer symptoms will recur after the simple closure of a perforation, but one must assume this risk realizing that, in emergencies particularly, surgery must be life-saving first and ideal afterward.

When these emergencies do not exist and after the patient with gastric or duodenal ulcer has had more than a reasonable trial at cure by medical means, the judgment of a surgeon will often be taxed as to what operative procedure will best fit the given case. This problem is simplified somewhat in the case of duodenal ulcer. Doctor Rodman believes that surgery should not play a very large part in such cases. Most duodenal ulcers will heal under careful dietary restriction and other medical means. If symptoms persist in spite of such management a gastro-enterostomy either alone or, preferably, in combination with infolding of the ulcer will cure the majority. In handling gastric ulcers, however, the choice of procedure is much more difficult. Recent advances in pathological and physiological knowledge together with the wide choice of excellent technical procedures have made this so. There are, however, certain principles which one must adhere to. The first of these is excision of the ulcer if at all possible, whether one does this by direct excision with the knife or by Balfour's cautery method matters little. In addition to such local excision one should overcome the pylorospasm in these cases by doing gastro-enterostomy or pyloroplasty by either the Finney or Horsley technic.

As might be expected the speaker is a believer in the principle of pylorectomy for ulcer since his father believed so firmly in this principle and was the first to suggest it in 1900 in a paper read before the American Surgical Association. He believed this the logical thing to do because at that time most ulcers were thought to be in the pyloric zone, and the majority thought that the instance of the development of carcinoma from ulcer was high. We now know that the majority of gastric ulcers are situated along the lesser curvature and we believe that only a small number of gastric cancers have their origin in ulcer. While these reasons, therefore, cannot carry as much weight as then, the very fact that accumulated experience has shown that permanent cures are much more apt to follow pylorectomy than gastro-enterostomy is sufficient reason in itself for continuing this principle in preference. Also, there can be no reasonable doubt that while cancer does not develop on ulcer nearly so frequently as was formerly thought, malignant degeneration will occur at times. The work of that excellent pathologist Doctor M. J. Stewart, of Moynihan's former clinic in Leeds, which shows that about 95 per cent of ulcers develop into cancer and that some 17 per cent of already developed cancers have their origin in ulcer fairly represents this matter. These figures also about express the average belief of many surgeons who do a considerable amount of gastric surgery. The reasons for preventing subsequent bleeding and perforation from the ulcer base by its complete removal are as sound today as when this principle was first proposed. Pylorectomy for ulcer is unquestionably a more serious operation than gastro-enterostomy and in the speaker's own experience is not as widely applicable as his father thought. In the presence of much inflammatory tissue he has found great difficulty in sufficiently mobilizing the pylorus to make a pylorectomy a reasonably safe procedure. In such cases a gastro-enterostomy will suffice as it is the general rule that when adhesions are too extensive to warrant pylorectomy they are also too extensive for a pyloroplasty. In these cases pylorectomy can follow at a later date, when often, after putting the pylorus at rest as has been done by the gastro-enterostomy, there will have resulted a sufficient quieting of perigastric inflammation to make the mobilization of the pylorus possible.

While a firm believer, therefore, in the principle of pylorectomy for ulcer, Doctor Rodman feels equally certain that the present-day enthusiasm on the part of some Continental surgeons and a few in this country for extensive gastric resections for gastroduodenal ulcer will quickly pass. One cannot help but feel that here the cure is worse than the disease and that this drastic procedure is not justified on pathological or physiological grounds.

In reestablishing the continuity of the gastro-intestinal tract after pylorectomy or partial gastrectomy Polya's operation as modified by Balfour seems to be an improvement on the Billroth II. It is time conserving certainly, and where it is necessary to remove a fairly large part of the stomach gastro-enterostomy is made most difficult. The speaker must

confess, however, to an entire satisfaction with the Billroth II technic in the average pylorectomy

His experience with pyloroplasty has been so limited as to hardly warrant the expression of an opinion of its value. Certainly Doctor Finney has enormously improved on the original Heineke-Mikulicz technic and in his hands it has a definite field of application with excellent results. One of the many reasons, however, why all of us recognize in Doctor Finney the surgical master is that he possesses to an unusual degree that most admirable of traits, surgical judgment. Therefore, one feels sure that, in his hands, pyloroplasty is only done when it serves the particular case better than any other method. Gastro-enterostomy either alone or in combination with local excision remains a useful operation. It is curative in duodenal ulcers and serves a useful purpose in those cases of carcinoma of the pylorus where radical removal is impossible and yet obstruction to the pylorus has developed. It is true that the serious matter of gastrojejunal ulcer will develop in the stoma at times but taking it by and large, gastro-enterostomy has been responsible for much relief from symptoms and many permanent cures.

DR JOHN SHELTON HORSLEY, of Richmond, Va., said that Doctor Finney's emphasis upon the necessity of following the results of a physiological as well as a pathological study of the stomach is important. The physiologic work of Cannon, Carlson, Luckhardt, Dragstedt, Kline and others has really formed a basis for our modern gastric surgery.

The physiology of the stomach may be divided into three general classes. First, the digestive function, second, the motor function, and third, the function of absorption. It seems necessary to keep these different functions in mind in order to reconstruct the stomach in such a manner that after the pathology has been removed or corrected its gastric physiology will be restored to normal as far as possible. There are several different operations on the stomach which may be indicated in different lesions. The surgical technic should be made to fit the pathology that is present, instead of attempting to stretch one surgical procedure in order to cover every lesion. When there is a small ulcer about the duodenum with but little surrounding infiltration and few if any adhesions, a pyloroplasty often gives excellent results. When the lesion of the duodenum is extensive and infiltrating a gastro-enterostomy is usually the best procedure.

Gastro-enterostomy may be unphysiologic, but so is amputation of an extremity. There are very definite indications for both procedures. The tendency to excise a large portion of the stomach for a small duodenal ulcer appears to be a swing to a too radical procedure for the lesion that is being dealt with. It would seem wiser to do a less radical operation for a small lesion with a possibility of a recurrence in a few cases when a more radical procedure can be utilized, than to employ an extensive gastrectomy as a primary operation in all cases.

An absence of acidity following partial gastrectomy is not solely caused by the removal of a portion of the stomach. The pyloric portion of the

stomach secretes alkaline material, and even if the acid secreting part is removed it does not include all of the acid-bearing gastric mucosa. Partial gastrectomy, or any operation which permits the free reflux of the highly alkaline duodenal contents into the stomach, causes a neutralization of the acid gastric juice. The chief element of alkalinity in the duodenal contents is the pancreatic juice. Any procedure, then, that will promote a free reflux of the duodenal contents into the stomach is likely to be followed by a reduction of acidity. This reduction, of course, is quite different from the achylia found in such diseases as pernicious anæmia or cancer, in which the gastric glands themselves cease to secrete acid, probably due to some toxic influence.

TRANSACTIONS OF THE AMERICAN SURGICAL ASSOCIATION

MEETING HELD MAY 2, 3, AND 4, 1929
(continued from page 800)

THE OPERATION FOR UNDESCENDED TESTIS

A FURTHER STUDY AND REPORT
BY ARTHUR DEAN BEVAN, M D
OF CHICAGO, ILL

THIRTY years ago at the meeting of the surgical section of the American Medical Association in 1899, I presented a paper on "Undescended Testicle and Congenital Inguinal Hernia," and reported a small group of cases that I had operated upon by a new method which I had devised. This paper was reported in the *Journal of the American Medical Association*, September 23, 1899. The foundation of this work was a method which I had developed for operating on congenital inguinal hernia. It was a very simple matter: the transverse division of the vaginal process about an inch below the internal ring, separating the peritoneum from the cord with great care not to do any injury to the structures of the cord, stripping the upper part of the vaginal process upward to the internal ring and ligating it as we do the sac of an inguinal hernia, then stripping downward from the transverse division of the vaginal process for a short distance and closing the lower part of the vaginal process with a purse-string suture so as to leave it as the tunica vaginalis of the testis. I thought at the time that the method was original. It is quite possible, however, that other surgeons have independently done the same thing in handling the open vaginal process in their cases of congenital inguinal hernia.

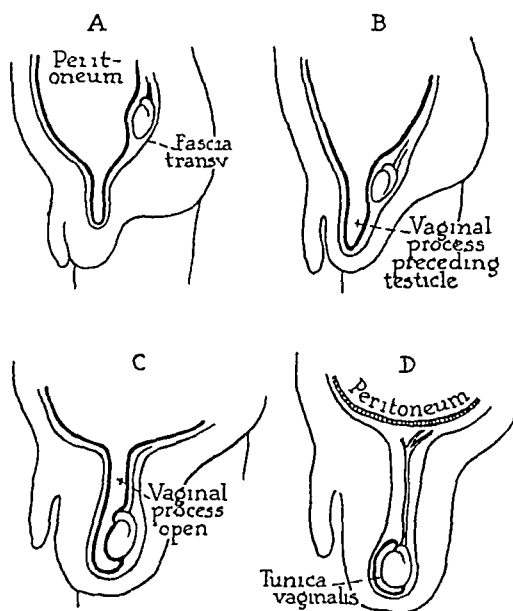


FIG 1—The descent of the testis

In 1898 I operated on my first case of undescended testicle, which was associated on one side with a well-developed congenital inguinal hernia. The case was a very favorable one for the placing of the testicle into its normal position. Both the hernia and the undescended testicle occupied a position in the groin. In the operation I did as I had done several times before in operating on congenital inguinal hernia: divided the vaginal process transversely, closed the upper end at the internal ring as we do the stump of an inguinal hernia, and then stripped the remainder of the vaginal process which

was closely united with the cord off from the cord for several inches, and closed the opening in this pouch of peritoneum with a purse-string suture I found that in doing this I had so lengthened the cord that I could, without tension, bring the testicle down to the middle of the scrotum I then made

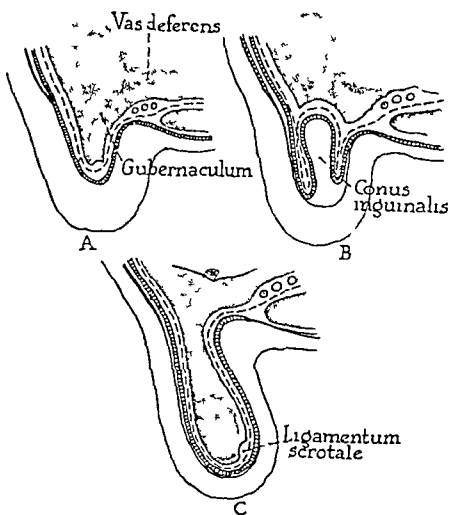


FIG 2—The descent of the testis

sufficiently to bring it down into the scrotum without any tension by stripping the peritoneal process off from the entire length of the cord and dividing some shortened strands of connective tissue in the cord, I then prevented its being drawn upward onto the groin by closing the neck of the scrotum with a purse-string suture of catgut This was the foundation of the operation for undescended testicle which I have now been doing for thirty years

Four years later I published a second article in the September 19, 1903, number of the *Journal of the American Medical Association*, on the "Surgical Treatment of Undescended Testicle"

In the meantime I had reviewed the literature

very fully and found that a number of surgeons had operated for this condition and that the most valuable contribution up to the date of my first operation was that made by Max Schuller in 1881, in which he pointed out and demonstrated, at operation, the fact that the most important factor in

a blunt dissection with my fingers and stretched a good-sized cavity in the scrotum on that side so that I could place the testicle in the scrotum without any tension I found, however, that in order to retain the testis in the new pocket which I had made, it was necessary to close the neck of the scrotum with a purse-string suture, leaving simply room for the cord, which was behind the suture and, of course, not included in it I then operated on the opposite side which was not associated with a hernia and found that with the same technic I could close the potential inguinal hernia on that side, free the testicle so that I could lengthen the cord

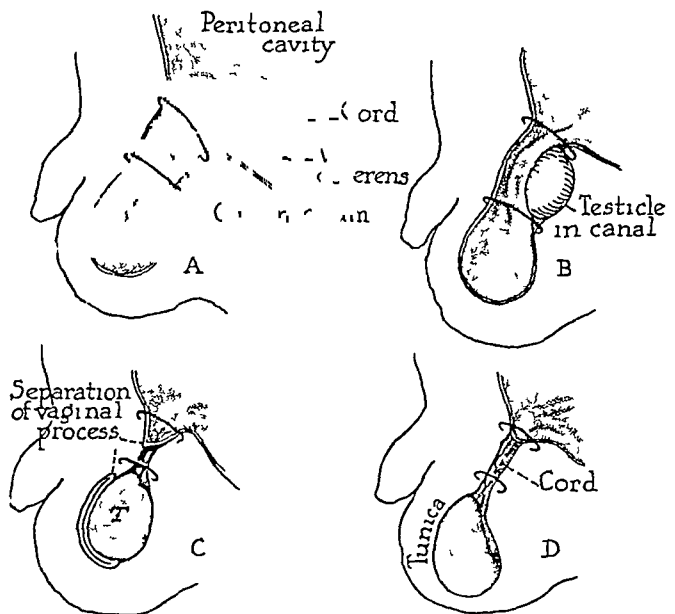


FIG 3—The descent of the testis

THE OPERATION FOR UNDESCENDED TESTIS

preventing the lengthening of the cord; so that the testicle could be placed in its normal position in the scrotum, was the unyielding vaginal process of peritoneum. Max Schüller found, as I had done, that this vaginal process of peritoneum was unyielding from the standpoint of lengthening it in any way. The peritoneum is very pliable; it permits of a very wide range of motion from side to side but is very inextensible. The contribution of Max Schüller was a most valuable one, but he did not develop the further necessary steps to bring the operation to a complete and successful conclusion. He stitched the testicle to the scrotum in order to

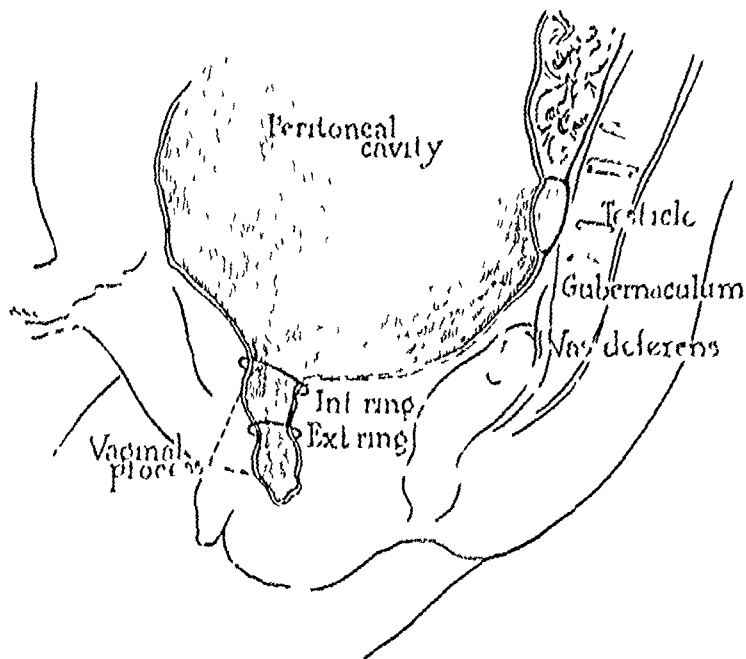


FIG. 1. The peritoneal process formed before the descent of the testis.

prevent retraction which, of course, was of no value.

In 1904 I published this work in *Langenbeck's Archives*, vol. lxxii, 1904. In 1906 I published this operation in *Keen's Surgery*. In the *Surgical Clinics*, of Chicago, December, 1918, after a larger experience with the operation I again presented the subject fully.

We have now had in my service a long and a large experience with operations for undescended testicle, and I desire today to review this subject and bring it up to date because I feel that the results which we

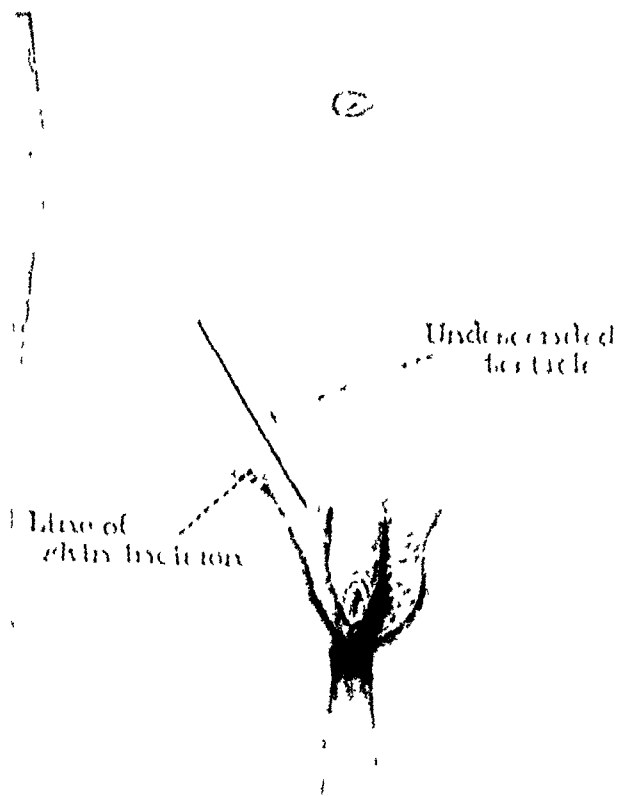


FIG. 2. The thin incision.

have obtained, and which we can now obtain by this method, warrant its general adoption. During the thirty years since my first paper in 1899, a

a great deal of work has been done on this subject by many surgeons in many countries. Many different methods have been employed, and the results of these methods reported. Many of the methods suggested, such as stitching the testicle into the scrotum or to the thigh and plastics on the scrotum, are unsound and unscientific, and a great deal of confusion has arisen in

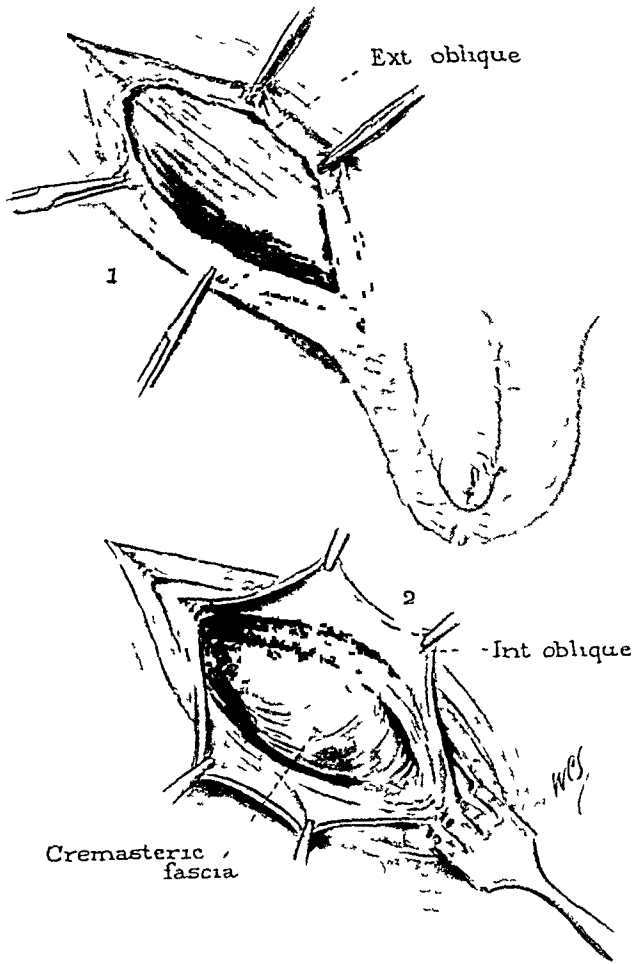


FIG 6—(1)—The skin and superficial fascia divided (2)—The external oblique divided

been required. The condition of course, may be unilateral or bilateral. The organ may be arrested anywhere in its passage from the abdominal cavity where, early in intra-uterine life, it lies behind the peritoneum and below the kidney, from this point it may be arrested in its original position, or anywhere from this point to the internal abdominal ring, in the canal, or at the external abdominal ring, or in some abdominal position like the groin or the thigh. Usually at the eighth month of intra-uterine life the organs are in their normal position. (See Figs 1, 2, 3 and 4)

There has been a legend passed down from one author to the other that if the organs are not in their normal position at birth that they may come down anywhere between birth and the age of puberty, and that legend, which

regard to this whole subject. There has developed out of all of this work a thoroughly sound and scientific method of operating for undescended testicle which is based upon simple, clear, definite anatomical, physiological and surgical principles, quite as simple and definite as the principles underlying our modern radical operation for inguinal hernia, or the Rammstedt operation for congenital pyloric stenosis. Before presenting the operation in detail I desire to draw briefly a picture of the condition. Undescended testicle occurs in about one out of five hundred males as shown by physical examination of recruits for the army in countries where compulsory army service has

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I believe now to be entirely erroneous, has led to our adopting a wrong point of view in regard to the age at which these cases should be operated upon. I fell into this error and stated on a number of occasions that inasmuch as the organs may descend in the period from birth to puberty that it was wise to defer operation until shortly before the age of puberty. I desire to state quite positively now that I think this position is erroneous, that there is little likelihood, if the organs are not in their normal position at birth, of their descending in the period from birth to puberty, and that I have never seen, in a large experience, a definite example of this kind. There is however, a not infrequent condition which makes it appear as though such a descent did take place and this condition I have studied very carefully and desire to report upon.

These are cases where there is a very rudimentary empty scrotum containing no testicles, but on careful examination one can feel the small testicles just beneath the skin above the scrotum, and with gentle pressure the testicles in these cases can be pushed down into the scrotum by running the fingers from above downward in the groin, and brought down so that they can be seen and felt definitely in the scrotum. When the fingers are withdrawn, the testicles slip up out of the little empty scrotum and apparently you have the condition of undescended testicle, when as a matter of fact that condition does not exist at all, because as these children grow up these testicles develop normally in the enlarging scrotal pouch and give the parents and the physician the impression that they are cases of undescended testicles which have come down in the period of puberty.

I have been repeatedly called upon to operate on these cases. I was at one time called to a distant city to operate on one of these cases by a very good surgeon who had invited some twenty or thirty surgeons to see the operation on the case. The little patient was sent to the operating room. I made a careful examination. There was nothing in the scrotum, but, without any difficulty, by gentle pressure of the fingers the testicles could be easily brought down in the scrotum, and I assured my surgical colleague and the parents that from my experience I was quite confident that the child would develop normally.

Year after year we have been operating upon these cases earlier and earlier, and I am coming to the position that any time after the first year or two after birth, whenever this deformity is discovered and is definitely demonstrated to exist, and the child is in good general condition, an operation should be performed, and it can be done at that early age to better advantage than at a later period. It is true that the structures are very small and the tissues very delicate and that in operating upon these young children it is necessary to use especially small, delicate artery and tissue forceps and instruments, also very fine catgut, everything in keeping with the very small and very delicate structure. There are, however, definite advantages in doing the operation at this early age.

First The structures are more pliable and yielding

Second The cord is more easily lengthened so that the organ can be brought down without tension

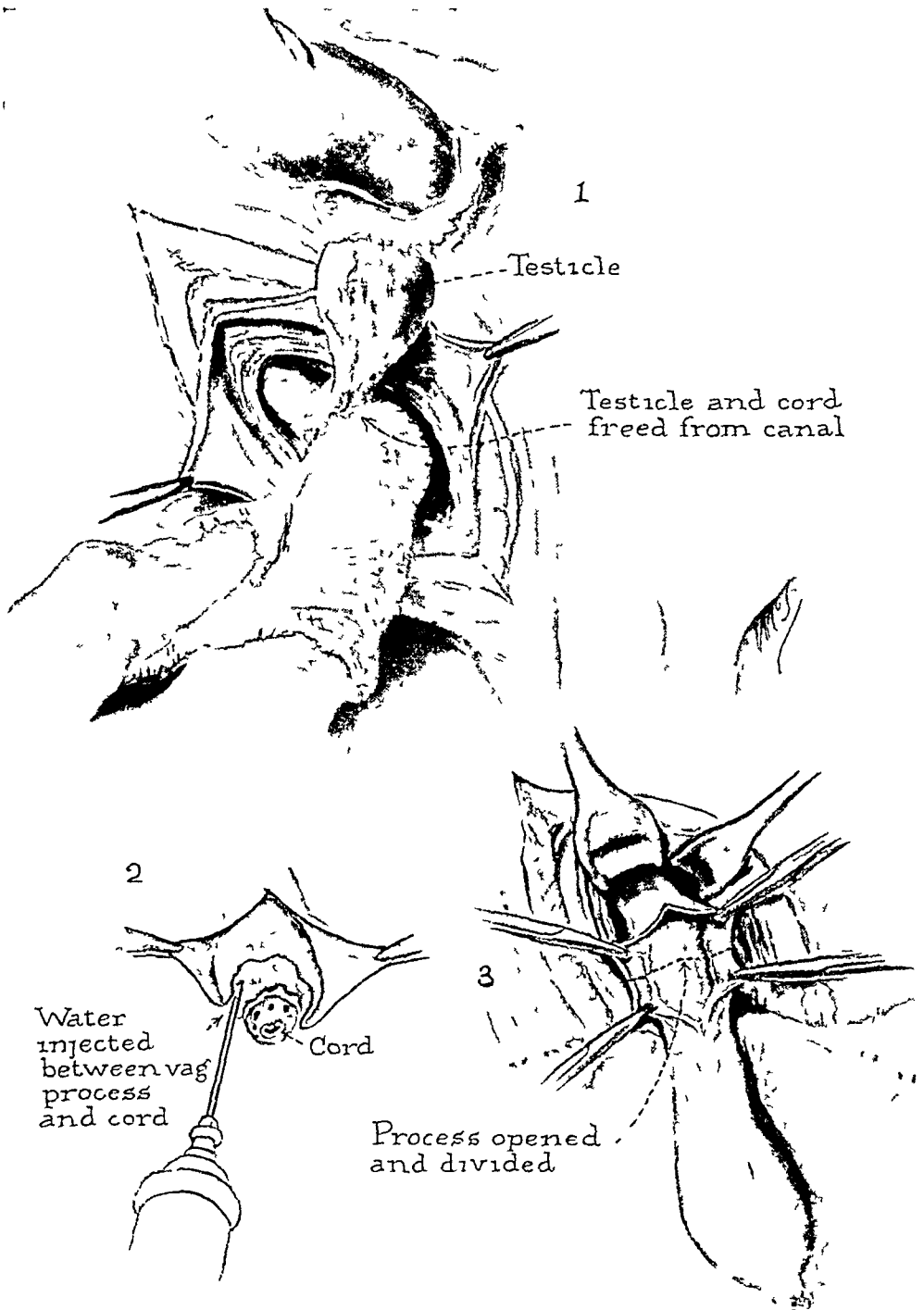


FIG 7—Freeing the testis

Third There is less danger of doing enough injury to cut off the blood supply

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Fourth I believe there is a better chance for normal development

The results which we have obtained in these very early cases have been most satisfactory During the last few years some interesting physiological

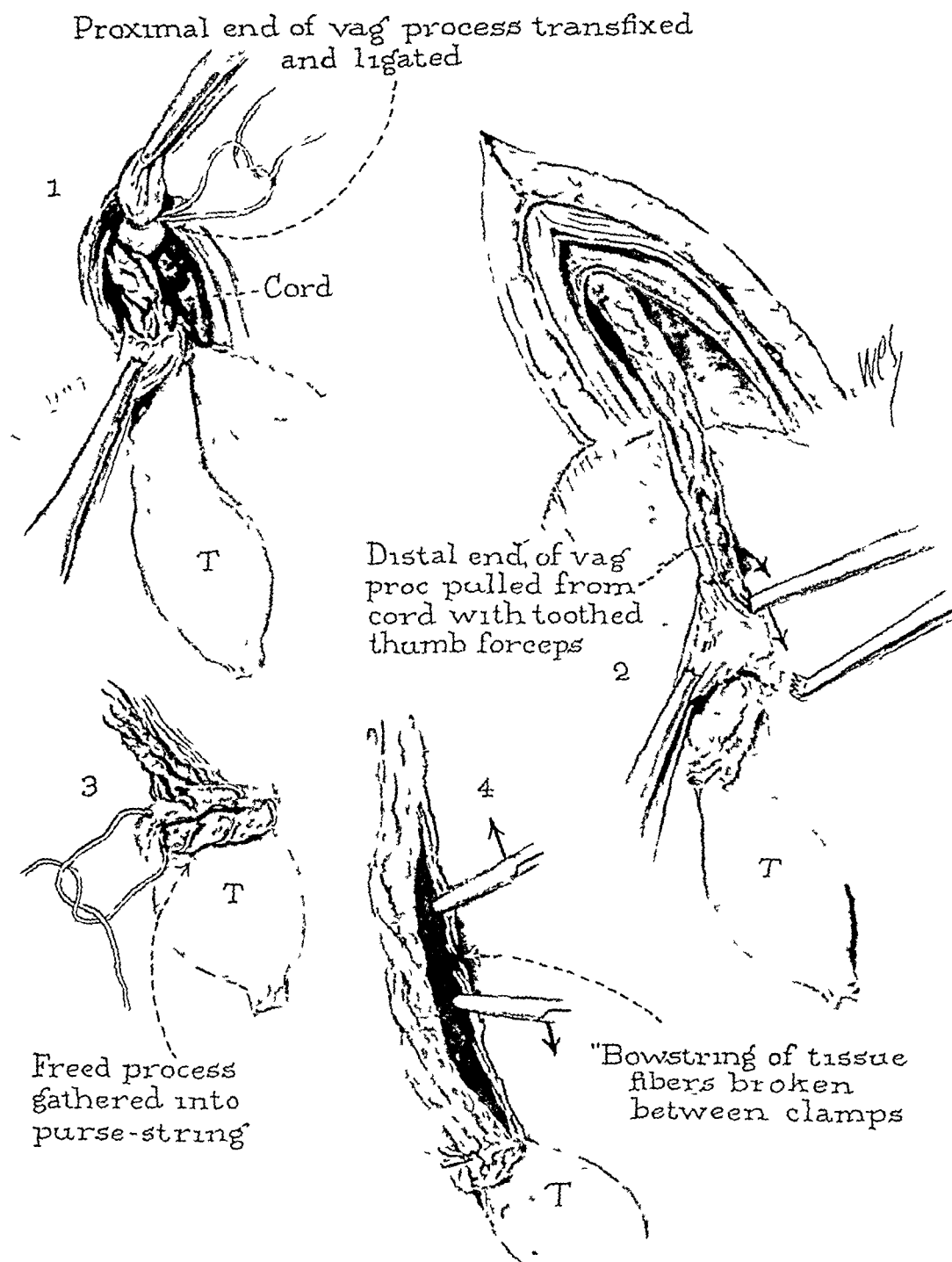


FIG 8

work has been done by Dr Carl Moore,¹ of the University of Chicago, on this subject of undescended testicle and the results of his work argue very strongly for early operation in this condition

I cannot present these articles in full but I desire to give you the essen-

trial facts Doctor Moore found in his experiments that if he took healthy young animals and placed the testicles into the peritoneal cavity that they

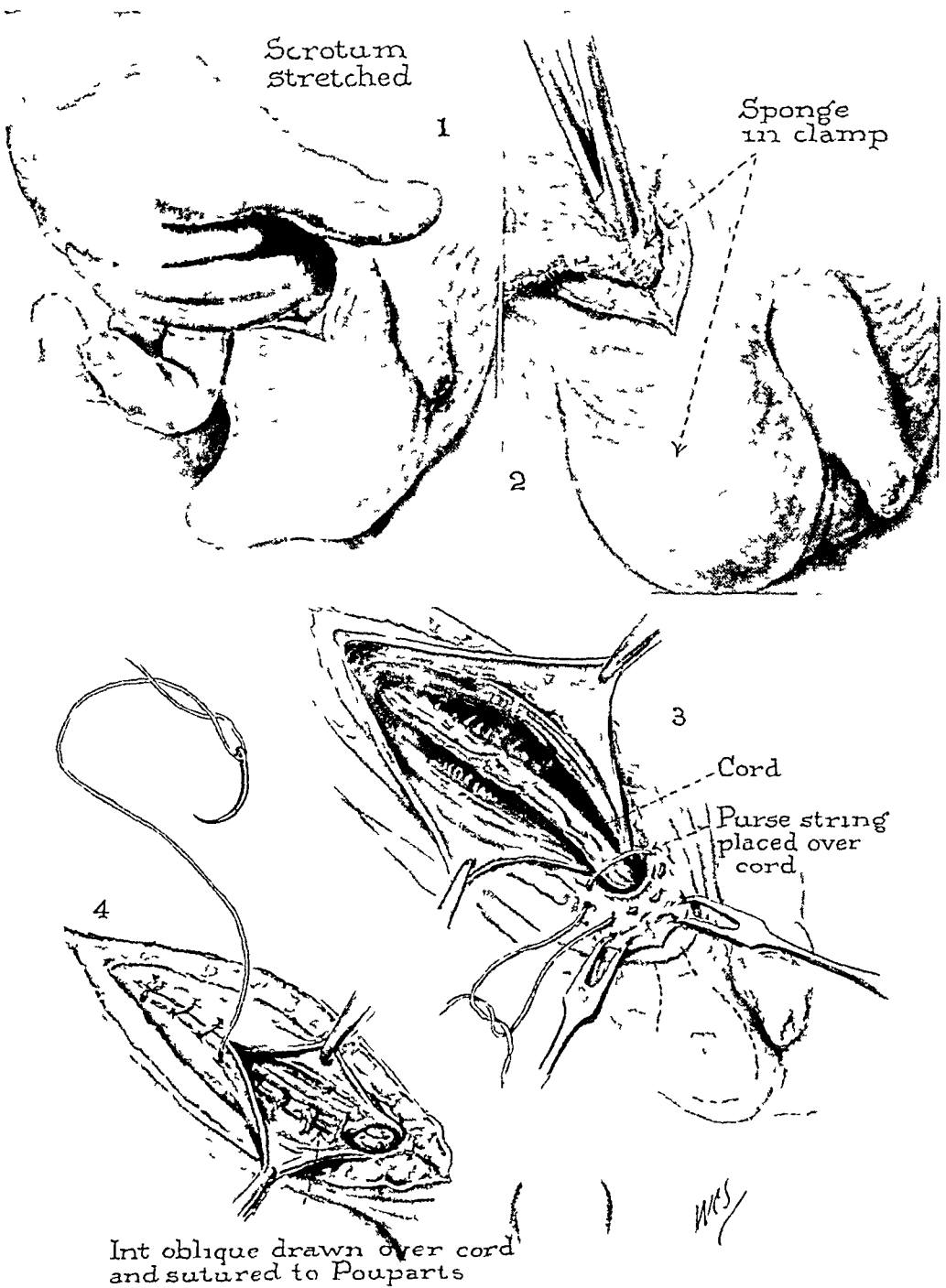


FIG 9

gradually degenerated and they did not develop to full function He found also that if after placing the testicles in the abdominal cavity for a short time, he then brought them back into their normal position, that the degenera-

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tive processes that had occurred in that short period were recovered from and that the organs went on to full development and functioning after being replaced in their normal position. He carried out some interesting experiments, demonstrating, as he thinks, that in higher vertebrates where the male gonads are in the scrotum and not in the abdominal cavity that the slight difference of temperature between their being in the abdominal cavity and in the scrotum makes the difference between a degenerated organ and one with full development and function.

If Dr. Carl Moore's conclusions are correct they form a strong argument for early operation for undescended testicle.

There are logical reasons why practically all of these cases of undescended testicle should be operated upon and operated upon early.

First Their failure of development in a normal way in this abnormal position, as demonstrated experimentally by Carl Moore and as confirmed by clinical experience.

Second The fact that they are all associated either with an actual hernia or a potential hernia which can be corrected at the time of the operation.

Third The importance both from a physiological standpoint and a psychological standpoint of relieving this deformity.

Fourth The greater danger from trauma in their abnormal position and, finally, possibly a greater risk of malignant degenerative processes.

In our large series of cases we have had no mortality from operation. With sufficient training and experience the operation can be done with little more difficulty than the ordinary operation for radical cure of hernia. Practically all of the children under the age of puberty who are brought to the surgeon should be operated upon, the large majority of those from puberty up to twenty years should also be operated upon, there are a limited number of cases of more advanced age, especially the cases which are unilateral, with one normal testicle and the retained testicle entirely within the abdomen so that it is not palpable and has never given rise to any trouble, where good judgment would veto operative procedures in these individual cases.

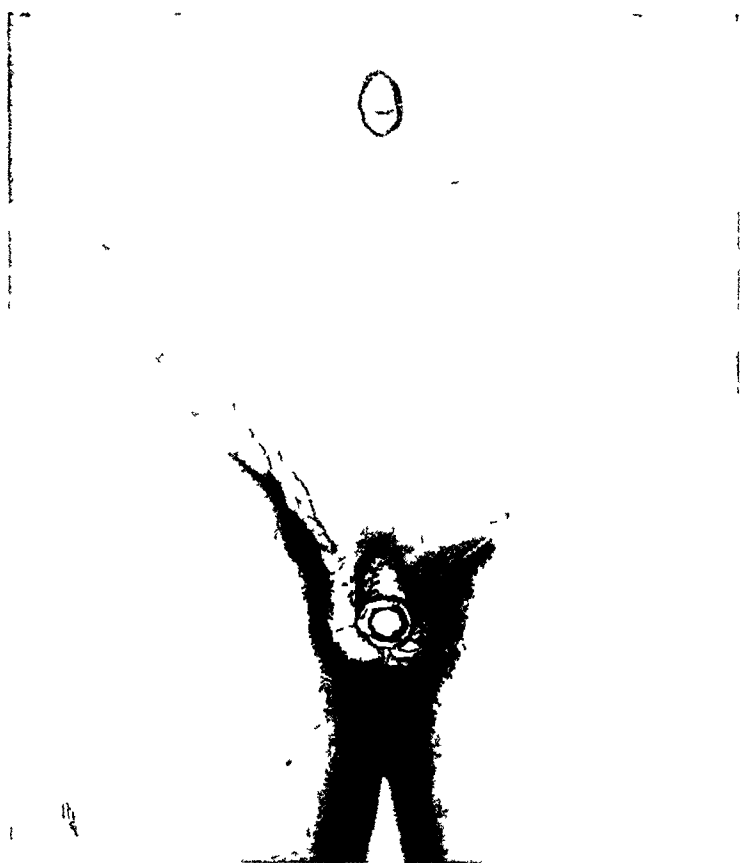


FIG 10 -The result of the operation

It is difficult to describe the details of the operation in words alone and on that account I have made a series of sketches which show the different stages of the operation which I shall present to you

Before doing this however, I want to say that I have been a good deal surprised and a good deal shocked at the evidence of the careless way in which many medical men read descriptions of operative procedures, and then without a complete understanding or without any mastery of the subject proceed to operate in a bungling way I would cite as evidence of this fact two examples In developing the operative technic I found that in a small number of cases, 5 or 10 per cent, I was not able to lengthen the cord sufficiently to bring the testicle down into the scrotum without tension unless I divided the spermatic vessels, so in this limited number of cases which may have been at first 10 per cent, and which has since dropped down to 5 and later to 3 per cent, rather than give up the operation and push the organ back into the abdominal cavity I divided the spermatic vessels, which enabled me to lengthen the cord sufficiently to place the testicle into the scrotum, this procedure necessarily carried some risk Much to my horror and chagrin I found that a number of my colleagues referred to the division of the spermatic vessels as the Bevan operation and proceeded to do the division of the spermatic vessels indiscriminately in all cases, with resulting atrophy and necrosis in a considerable percentage As a matter of fact we have not ligated the spermatic vessels in a single case for the last four or five years, because with increased study and experience we have been able, without the division of these vessels to bring the organ down into its normal position without tension I should not, however, hesitate a moment in a case where it was impossible to do this to ligate the spermatic vessels and to bring the testicle down into the scrotum rather than to place it back into the abdominal cavity

As another example of the casual way some medical men read descriptions of operations, one of my German colleagues in referring to the purse-string suture which I place at the neck of the scrotum in front of the cord leaving ample room for the cord behind, after reading my article stated that he thought it was bad surgery to put a purse-string suture at the neck of the scrotum surrounding the cord because it was sure to interfere with the circulation of the testicle

The various steps of the operation are very simple and very easily understood Undoubtedly one can acquire by experience in a number of cases a manual dexterity in handling these delicate tissues that will enable the operator to improve his technic and his results

The patient is anæsthetized usually with ethylene I shall attempt to describe to you the details of the operation

The incision made is exactly the same as that which we employ in operations for the radical cure of hernia I am careful not to extend the incision into the scrotum, but keep it just above the scrotal tissue (Fig 5) I divide the skin and superficial fascia, and in the superficial fascia I divide the small arteries and veins, branches of the femoral artery and vein, that pass up above Poupart's ligament, at the lower angle

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of the incision the superficial external pubic, and about the middle of the incision the superficial epigastric

After dividing the skin and superficial fascia and clamping these small vessels, I expose fully the white shining aponeurosis of the external oblique, and as I approach the external ring I come to the testicle, which is surrounded by a large peritoneal sac and covered by the three layers of fascia found in inguinal hernia (Fig 6-1) I very carefully separate this peritoneal sac from the surrounding fascial layers. I now split the external oblique over the canal for a distance of about two inches well up to the internal ring (Fig 6-2) I am now able to bring the testicle out of the incision and place it upon an abdominal pad. Making a little tension on the testicle and the peritoneal sac surrounding it, I bring that part of the peritoneal process surrounding the cord well into view and free the cord well up to the internal ring (Fig 7-1)

The next step of the operation is to divide the peritoneal process transversely at a point about an inch below the internal ring. This requires a delicate dissection, and we have developed some operative technic that is of value. I first split the vaginal process by a short incision, about one-half inch in length, parallel with the cord. I then place on the edges of the incision in this thin peritoneal process four small artery forceps, mosquito forceps, so as to be able to make the peritoneum tense (Fig 7-3) It is difficult to dissect off the peritoneal vaginal process from the cord. In order to facilitate this dissection I take a fine hypodermic needle and syringe and inject some normal salt solution under the peritoneum, so as to lift the vaginal process up from the cord (Fig 7-2) This makes the separation of the peritoneal process much easier. The peritoneum is so delicate in the child, being like tissue paper, that you must make a very delicate and careful dissection. I have now completed the transverse division of the peritoneal process, and have stripped the upper part of the vaginal process well up to the internal ring. I now ligate this upper end that enters into the general peritoneal cavity with catgut ligatures, just as we do the stump of a hernial sac (Fig 8-1) Picking up the lower portion of the vaginal process with fine dissecting forceps with teeth, I strip it down from the cord so as to expose the entire length of the cord uncovered by any peritoneum (Fig 8-2) The lower part of the peritoneal pouch is used to make a tunica vaginalis for the testicle. This is accomplished, either with a purse-string suture or simply a running catgut suture closing the opening (Fig 8-3) As I lift up the testicle and the cord there is still some tension, but I find as I examine it carefully that this tension, preventing a sufficient elongation of the cord, is due to some shortened fibrous bands, which I tear across between dissecting forceps. These bands are derived from the fascial coverings of the cord and the vaginal process. I regard this as an important step in the operation, and it is one that should be thoroughly understood (Fig 8-4) One can with care divide and tear these shortened fibrous bands, leaving simply the vas and its vessels and the spermatic vessels, without interfering in any way with the essential structures in the cord. You will see that by this manipulation you have been enabled to free the cord, as a rule, for four or five inches, a length quite sufficient to place the testicle in the scrotum without any tension whatever. With the index and middle fingers and a blunt dissection, and by packing into it enough gauze, I now make a large pouch in the scrotum which must be large enough to receive the testicle without compromising it in any way (Figs 9-1 and 9-2) The scrotal tissues are so elastic and so yielding, that with the gloved fingers and gauze packing we have always been able to make a scrotum large enough to receive the testicle without pressure. The organ is now placed in this pouch, and with a purse-string suture of catgut the neck of the scrotum is closed, this suture being one that simply goes through the superficial fascia and does not involve the skin or include the cord. This suture must not endanger the blood supply of the testicle (Fig 9-3) This prevents the testicle slipping up into the groin, and keeps it well down in the scrotum. The canal is now closed, not as in a Bassini operation, but with the cord deeply situated in the canal, the transversalis and internal oblique are sewed to the shelf of Poupart's ligament over the cord, and the

external oblique is then closed (Fig 9-4) The skin and superficial fascia are closed in the same way that we would close them in a hernial operation You will find that the organ is now in the scrotum without any tension whatever, looking very much the same as on the other side (Fig 10)

I would like to emphasize the fact, that the technic must necessarily be difficult to one who undertakes it for the first time, especially without having had the opportunity of seeing a number of these operations done by one who has had experience with it I would also like to emphasize the fact, from my observation of the cases that have been done by some inexperienced surgeons, that the operation has not infrequently been undertaken by men who have not fully understood the technic of the procedure, and who have not carried it out in all its details I would like also to emphasize very strongly the fact, that division of the spermatic vessels is but exceptionally called for, and is not at all an essential part of the operation which I have developed, that it is in our own hands not necessary in 5 per cent of the cases On the other hand, wherever it is indicated it should be done and done thoroughly, on the principle that the basic idea of my operation is the necessity of placing the testicle in the scrotum without any tension whatever Care should be taken in the primary dressing of the case not to put on enough pressure over the groin to interfere with the circulation in the cord

On the whole, the operation seems to me to be one of the most interesting pieces of surgical anatomy in the whole field of operative surgery The skilful unraveling of this congenital condition, which enables the surgeon to accomplish in a half hour by good operative technic what requires weeks and months in the process of development, with, as a rule, perfectly satisfactory results, has furnished one of the most satisfactory examples of modern surgery

REFERENCE

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DISCUSSION DR JOHN H JOPSON, of Philadelphia, expressed the satisfaction with which he had practiced Doctor Bevan's operation for many years At the Children's Hospital and elsewhere he had had occasion to see a good many of these cases both in the wards and in private practice A good many years ago he reported a small series before the Philadelphia Academy of Surgery He received many requests for reprints of that paper, showing what an interest there was in the subject at the time

A much more extensive experience with the operation and a checkup on the literature from time to time had further confirmed his opinion that this is, as Doctor Bevan has said, practically a standardized operation If the profession follows the directions which he has laid down and the points which

he has emphasized today, and especially with reference to the careful division of every tiny band of fascia along the vas and the vessels, very few indeed are the cases in which the testicle cannot be brought down to a satisfactory position in the scrotum. The cases are very few in which either the Ombrédanne operation or the operation of Torek will be needed. He thought that the efficacy of the original Bevan operation, in the hands of one who is accustomed to practice the operations for hernia in children, had been amply demonstrated.

As to the time at which this operation should be performed, his own practice had been to advise that unless there is a troublesome hernia associated with it, it should not be done before the age of six years and always before the age of twelve.

As to the percentage of these cases which have a hernia association Eccles in his book written many years ago said, "the association of hernia was 60 per cent", Bull has said, "they always have hernia," which is certainly far from the truth. His own experience corresponds more nearly with that of Eccles.

DR JOHN B WALKER, of New York City, said that at the Hospital for the Ruptured and Crippled, during a period of twenty-eight years, there were observed 80,736 cases of inguinal hernia in the male, of which 1357 or 1.68 per cent were cases associated with an undescended or maldescended testis. Four thousand four hundred fifty-three cases of inguinal hernia were operated, of which 334 or 7.5 per cent were associated with an undescended testis.

In 50 per cent of these cases, the ages varied between eight and twelve, but in cases associated with a large hernia, the operation was performed at an earlier age, for it was found inadvisable to use a truss as it caused pain and an irritating pressure upon an already undeveloped organ.

The Bassini operation was employed, but the cord was not transplanted and it was brought out at the lower end of the wound in the largest number of cases. Very rarely was it necessary to divide the vessels, the main objective being to dissect most carefully and to divide the finest fascial fibres, suturing the testis to the bottom of the scrotum is not advised. Practically all cases were accompanied with a hernial sac.

Results—As regards location of the testis, over 50 per cent remained in the scrotum or outside the external ring. As regards sarcoma, the undescended testis is more liable to trauma and it also shows a greater tendency than the normally placed testis to undergo malignant degeneration.

DR ALEXANDER PRIMROSE, of Toronto, Canada, had performed the Bevan operation a good many times with satisfactory results. He asked Doctor Bevan and others who had had an extensive experience with the undescended testis, if they consider the possibility of malignant development in the retained testis an indication for placing it in its normal position. Also if in their experience an undescended testis is frequently associated with other

failures in development. He asked these questions because of the findings in the following case which presented certain features of interest.

A good many years ago he was assisting his senior colleague in Toronto in removing a large malignant mass from the abdominal cavity. The tumour growth had occurred in an undescended testis. After an extensive operation the patient died and at autopsy instead of the diminutive structure, usually called the "uterus masculinus," which exists as an offshoot from the floor of the prostatic urethra, there were a complete uterus, tubes and vagina.

The case was of further interest because it proved conclusively that the so-called "uterus masculinus" represented not only the female uterus but in addition the vagina. This fact was obvious because the cervix of the specimen possessed the well-marked "plicæ palmatæ" which is a characteristic marking on the mucous surface of the normal cervix. Distal to the cervix was the body of the uterus and on its proximal side the vaginal tube which joined the urethra. This case was reported in full in the *British Journal of Anatomy and Physiology*, vol. XXXIII, p. 64, October, 1898. This case has been quoted more than once in the literature because it affords conclusive proof that the so-called "uterus masculinus" represents not only the uterus but also the vagina.

It would be of interest to determine in a large series of cases (1) The frequency of the development of malignancy in the testis retained within the abdomen, and (2) whether or not other failures in development are frequently associated with undescended testis.

DR ALEXIS V MOSCHCOWITZ, of New York City, said that he in 1910 published an article in the *ANNALS OF SURGERY*, entitled "Anatomy and Treatment of Undescended Testis, with Special Reference to the Bevan Operation." This paper had given him more trouble than any other he had ever written. For the conclusions contained therein, he had to apologize before the New York Surgical Society and before the surgical section of the New York Academy of Medicine. The final conclusion of the paper is as follows: "The purpose of this paper is, therefore, an advocacy of the Bevan operation. I do this not only from a sense of pleasure over the results that it has afforded me, but also because the operation, in the infrequency with which the operation has found its way into the literature is a criterion, has thus far found few adherents."

Primarily, he thought that the operation had been greatly misunderstood. This misinformation lies in the fact that the division of the spermatic vessels is looked upon by the majority as the essential part of the Bevan operation. This is not so, on the contrary, today, Doctor Bevan himself advised very strongly against it.

The paper previously alluded to was based upon eighteen patients who were operated upon by the Bevan method. Since that time he had operated a larger number of patients. A few years ago he sent for as many of these patients as he could follow up. The total number was 130 and a fair number returned for examination. To his great surprise and chagrin, in all cases but

THE OPERATION FOR UNDESCENDED TESTIS

two, when the spermatic artery was divided, there was a complete atrophy of the testis. It is not surprising, therefore, that he had given up entirely this part of the operation.

He believed that the crux of a correct operation for undescended testis lies in a complete mobilization of the testis without the least injury of the spermatic vessels. If it is impossible to obtain this through the ordinary inguinal incision, distal to the internal inguinal ring, extend the incision somewhat upward and separate the internal oblique and inguinal transversalis muscles, as in the McBurney incision. Through this incision the spermatic vessels are mobilized as high up as possible, and in a majority of instances it will be found that the testis can be mobilized sufficiently for transplantation into the scrotum.

DR WILLIAM E. LOWER, of Cleveland, Ohio, said that the operation which Doctor Bevan had described has been a great advance in the treatment of this class of cases.

He had done this operation as nearly as possible, as he has described it, but occasionally had atrophy of the testicle result. Perhaps he had stripped off the cord too closely. Yet, it seemed to him that there are some of these cases in which it is almost impossible to get the full length of the cord without dividing all the vessels, except those accompanying the vas.

One point is important, namely, that there must be no tension on the testicle. The cord should be long enough to be laid down beside the scrotum without tension. Wherever there is much tension the operation will fall short of the purpose. Methods of holding the testicle down in the scrotum are as a rule failures.

If this operation can be done upon younger children, and Doctor Bevan has demonstrated that it can be, the results will be much better. One can perhaps prevent some of the calamities which have occurred later.

DR FRANZ TOREK, of New York City, said that he was pleased to hear Doctor Bevan use the expression, "freeing of the vas and vessels," and not "the freeing of the cord," because in proceeding simply to free the cord as a whole one will often fail to get the testicle down far enough. The cord has to be considered as consisting of two separate parts, the vas and the vessels. The vas never gives any trouble, the vessels often do.

The picture that he has shown of the finished case is also an ideal one. The testicle rests in a properly pendulous scrotum which is the ideal position. He had not had the good fortune of seeing Doctor Bevan's personal cases but he had seen a great many others that were operated according to Doctor Bevan's method, and the vast majority of them did not show the result seen in this picture. They have had a testicle somewhere very close to the pubis, a position which is not desirable because the testicle is then exposed to the danger of injury from any blow.

Having seen so many results in which the testicle had slipped up again to the pubis and even higher, he had gone a step further than simply placing it into the scrotum. In an article published November 13, 1909, in the *New*

York Medical Journal, he described the method that he had been using. It consists in freeing the vas and vessels according to the method which has been shown today. After the freeing of the vas and vessels the testicle is brought out through an incision in the scrotum, then carried through an incision in the skin of the thigh to the fascia of the thigh to which it is anchored without any tension whatever, the wounds of the skin of the scrotum and of the skin of the thigh being sewed to each other. In that condition the testicle cannot slip back. It is not under any tension. If tension of the vessels were permitted, the performance of the operation would not be in accordance with his advice.

The result is that after the scrotum and testicle are again released from the thigh the testicle invariably rests at the bottom of a pendulous scrotum.

While the testicle should never be under any tension, the scrotal skin is under a slight degree of tension by being brought down to the thigh. This is not a disadvantage because skin stretches very easily, but on the contrary it is an advantage because it forms a scrotum. In many of these cases there isn't any skin to amount to anything at one's disposal, but by this operation a scrotum is made. It never takes longer than three months to make such a scrotum by attaching the rudimentary scrotum to the thigh. In many cases it could be removed very much earlier.

DR HENRY H M LYLE, of New York City, thought that Doctor Torek had added a physiological refinement to Doctor Bevan's operation which makes for better end-results. It is interesting to note that when this subject was under discussion at the Surgical Section of the New York Academy of Medicine and the end-results of Torek's operations were demonstrated by Dr Herbert Meyer, it was the unanimous opinion that the results shown by him were remarkable. The testicle was freely movable in a swinging pear-shaped scrotum, which to all appearances was fully developed. He felt sure that his own end-results had been materially improved since he adopted Doctor Torek's operation as his standard. He had seen no atrophy, the testicles had increased in size and are freely movable at the bottom of a well-developed scrotum. Quite lately he had a testicle that was so large that there was insufficient room in the poorly-developed scrotum to hold it. Now the testicle is in a normal mobile pear-shaped scrotum. It is too early yet and it is a difficult matter to get figures on the functional end results, but if increase in size and development go hand in hand, then the Torek operation should yield good functional results.

DR CHARLES A PORTER, of Boston, Mass., remarked that the interesting question in connection with these cases is not so much where the organ is but whether it is worth anything where it is.

He would like to hear some reports on the ultimate results, what percentage of cases of undescended testicle has been subjected to either one of these operations and has continued to develop and become a useful pubic organ? He happened to know from experience that one cannot strip the cord in a young child and expect more than about 50 per cent of them

to continue to develop in comparison with the opposite testicle that happens to be down. It will arrest the development. Have these individuals who, prior to the operation, one had reason to believe would be sterile, been rendered not only free from their deformity but made fruitful members of society?

DR ARTHUR D BEVAN (in closing the discussion) said that, in the first place, undoubtedly it is difficult, unless one has seen the operation done by one with a good deal of experience, to do the operation from simply a written description of it. He had attempted in his paper to present those points that he thought might help out.

There are two points which he wanted to bring out particularly. The first is the importance of operating upon these cases early. Since surgeons have been operating upon younger children the operation has become easier and the results have become better. Some men advocate operating on these children as early as the first year, right after the child has been weaned. He had not gone that far, but one can say that if the operation is done within the first three or four years the results will be very much better than they have been in the past.

He emphasized the importance of the work of Carl R. Moore, referring to his pamphlet entitled, "Scrotal Replacement of Experimental Testis and the Recovery of Spermatogenic Function in the Guinea Pig." It is a reprint from the *Biological Bulletin* of August, 1926. The reprint also contains some references, not complete but interesting and valuable, to the speaker's work, the work of Joseph Griffis that was done as early as 1893, the work done by Lipschutz and seven or eight papers which have been done by Moore.

Moore's contribution shows beyond any question this fact. If the testis is left in the abdominal cavity or in the canal it never does develop. Certainly in lower animals where one can control the situation Moore has shown that it does develop and function if placed in the normal position.

TOTAL CYSTECTOMY AND PARTIAL PROSTATECTOMY FOR INFILTRATING CARCINOMA OF THE NECK OF THE BLADDER

REPORT OF EIGHT OPERATED CASES

BY EDWIN BEER, M D

OF NEW YORK, N Y

ALMOST all the tumors of the bladder that we are called upon to treat arise from the epithelial layer. Most of these tumors some twenty years ago failed to respond to surgical treatment, but during the last two decades certain groups of these epithelial tumors have been proven to be amenable to surgical curative methods.

A fair proportion of these epithelial growths are surface tumors and do not, when first seen, infiltrate the bladder wall even though they may recur subsequently—perhaps years later—as either surface tumors or as infiltrating neoplasms. Whenever the tumors are definitely surface tumors with no tendency to infiltration, they can readily be destroyed through the cystoscope with the high frequency current or by proper surgical technic through a suprapubic incision, measures being taken to prevent implantation of live tumor cells on the raw surfaces as well as measures to protect the parietal wound.

In those tumors that infiltrate the bladder wall, the therapeutic measures are much less successful, and depending upon the degree and extent of infiltration, the results of therapy vary. It can be said that tumors situated in the posterior, lateral or anterior walls, even if they infiltrate, can be successfully resected, and this applies to papillary carcinomata as well as solid infiltrating carcinomata.

In the tumors of this group which involve a single ureter and reach close to the neck of the bladder at one point, successful resections with the electric knife, or the electric cautery with re-implantation of the ureter in a new place, or ligation of the ureter, are perfectly feasible and frequently give satisfactory results even though one must admit that it is often difficult by palpation to determine accurately the limits of the infiltration and thus make the incision well outside of the tumor area. Primary coagulation of the tumor surface, before the excision with the electric knife, is, undoubtedly, the best way to prevent breaking off of implants. Another aid in controlling implants is filling the wound with alcohol for five minutes before suturing the resected bladder.

Unfortunately, however, in addition to the groups included in the above descriptions, there is a group of cases in which the trigone is so extensively involved that the ureters cannot be spared and both ureters have to be sacrificed. In addition, many of these cases have extensive involvement of the

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neck so that the infiltrating growth involves half or more of the sphincter area and has invaded underlying tissues, particularly the adjacent prostatic tissues in the male. In this group of extensive infiltrating growths situated close to or in the neck of the bladder involving frequently the ureter orifices, the problem is most serious. What should we do? What can we offer these patients?

This paper is prepared as a contribution to this subject and deals with one form of treatment for this group of desperate cases.

Up to date, four methods of treatment have been applied to the cases falling in this group:

- 1 Suprapubic cystostomy to relieve the local irritation, bleeding, tenesmus, etc
- 2 Suprapubic cystotomy with more or less deep electrocoagulation
- 3 Suprapubic cystotomy with introduction of radium seeds deep into the infiltrating growth
- 4 Total cystectomy and partial prostatectomy

Treatment No. 1 is evidently purely palliative and often fails to give real relief—pain, bleeding and tenesmus continuing almost unchanged.

Treatment No. 2—electrocoagulation—is usually little more than palliative, as electrocoagulation frequently will not extend to any great depth, and if the tumor is deeply infiltrating, the electrocoagulating current will fail to reach the deeper layers.

The third method—introduction of radium seeds—has, undoubtedly, every once in a while destroyed deeply infiltrating growths in and about the neck involving the trigone, but even with the radium seeds the results are most irregular, inconstant, and only a few cases have been definitely cured by this procedure in a series of almost three dozen treated in this way. Patients treated with radium are, as a result of the radium irritation, liable to be rendered most uncomfortable for months, and if the radium is placed in the bladder wall near the ureter orifice, cicatricial stenosis with subsequent hydro-ureteronephrosis, which readily becomes infected, frequently develops.

The three methods just mentioned of dealing with this group of unfavorable cases have to compete with the fourth method which really offers something to these unfortunate cases, and during recent years a number of surgeons have been studying the problem presented by such cases and have been recommending more radical surgical procedures. Whether, in the long run, total cystectomy is going to prove to be the method of choice, it is impossible to say at this moment, but those of us who have given total cystectomy in this group of cases a trial, must feel a certain compulsion to put our cases on record so that ultimately we can determine what patients have gained by this method of approaching the problem as compared with the three other methods mentioned above.

The textbooks on surgery and some of the recent papers have placed such a high mortality on total cystectomy that the average surgeon dreads to undertake such an extensive and more or less mutilating procedure.

According to Zuckerkandl,¹ the mortality of total cystectomy, as shown by sixty-four cases collected from the literature, was 50 per cent. This high mortality was attributed to the fact that the operation was done in one step. Scheele,² in a more recent review in 1923, came to somewhat similar conclusions and stated that the operation should be done in two steps regularly, as it diminishes the mortality. In the first step, the ureters were to be disposed of—preferably by implantation into the sigmoid, and in the second step, the bladder was to be removed well outside of the involved area with the adjacent fat, etc. In forty-three cases collected by Scheele—in which the operation was done in one step—there was a mortality from operation of 53.5 per cent, whereas in seventeen cases operated in two steps, three died following the first operation, and of the fourteen that remained, two died following the second operation. Thus, in seventeen cases in which the two-step operation was done, there were five deaths, or a little less than 30 per cent mortality. Janssen³ quotes very similar figures based on the publications of Wildbolz, Watson, Verhoogen, Reischmer and Petrow, the mortality varying in this operation from 50 to 60 per cent. He concludes with Wildbolz, in view of the high mortality, that total extirpation of the bladder in extensive new growths is not to be recommended. H. H. Young⁴ writes in the same strain, "the high mortality and the rarity of success render this operation thoroughly unjustifiable."

More recently, Federoff⁵ has published a series of seven cases of total cystectomy and has also recommended a two-stage procedure, the ureters being introduced into the sigmoid at the first operation. Some of the patients on whom he had been able to carry out the two-stage operation were alive five and six years following the total cystectomy. Unfortunately, at least three cases, out of the twelve cases underlying his report, died following the ureter anastomosis before the cystectomy could be carried out. In one case he did a bilateral nephrostomy, and in another he transplanted the ureters into the anterior abdominal wall without touching the bladder. In a later report published in Russian,⁶ Federoff is said to have carried out total cystectomy in ten cases, and according to this report, he still favors the above method of procedure in two steps. More recently, Coffey also has declared for primary transplantation of the ureters into the large intestine according to his technic with a secondary total cystectomy. In his recent paper⁷ he reports one such operated case.

Another point must be considered in connection with this whole problem and that refers to the advisability of attempting a total cystectomy in the presence of definite metastases. Carcinoma of the bladder most frequently remains localized and distant metastases are not common. In fact, in sixty-one cases of total cystectomy collected by Scheele, only five had metastases. Unless the metastases are so placed as to make the condition absolutely hopeless—e.g., in the lungs, liver or spine—it is questionable whether patients should be refused the relief from torture afforded by total cystectomy. In one of my cases (Case II) the local metastasis in the pelvis remained quiescent

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for five years, and in another (Case VIII) radium seeds were placed in an iliac gland deposit that could not be removed. Local metastasis surely should not contraindicate total cystectomy and perhaps even distant deposits should frequently be ignored, in view of their usually slow progression and the great relief given to the patient from his local condition by total cystectomy.

From the above brief summary several conclusions might be drawn. First, that the mortality of total cystectomy at present is high unless operation is done in two steps, second, that there is a definite mortality following the transplantation of the ureter into the bowel as the first step in the operation, and third, that a number of patients in whom total cystectomy has been done have been relieved of their local condition and remained well for many years following the operation. The exact duration of life following this operation in sixty-two cases collected from the literature by Scheele has been carefully tabulated in his paper.⁸ Unfortunately, many surgeons have published their cases shortly after the operation and the end results are not known. From Scheele's tabulation, I gather that in the sixty-two cases reported, sixteen patients lived over one year, and seven patients lived over three years—the longest period being fifteen years.*

The disposition of the ureters in these cases has up to date presented one of the main problems. No matter where the ureters are transplanted, attacks of pyelonephritis and secondary hydronephroses with infection are liable to develop. The greatest ingenuity has been employed to meet this problem. The ureters have been transplanted into the sigmoid intraperitoneally, into the rectum on its extraperitoneal surface, into loops of the intestine separated from the intestinal tract, into an excluded loop of the sigmoid, an artificial anus having been made in the upper sigmoid. They have also been left in the wound or transplanted into the urethra, or into a more or less closed-off vagina. In some cases the ureters have been brought out to the skin near the incision or near the anterior superior iliac spine, and in others again, the urine has been deflected by a nephrostomy or lumbar ureterostomy.

In an extensive review of this whole subject published by M. Papin,⁹ he has analyzed a large series of cases (181 total cystectomies) in which the urine was deflected from the bladder, and he has found that the mortality of implantation in the intestine, according to published reports, is 59.2 per cent, implantation into the vagina 50 per cent, implantation into the urethra 100 per cent, whereas, implantation of the ureters into the iliac fossæ or lumbar regions or into the wound as well as deflection of the urine by nephrostomy, is accompanied by a mortality of 28.7 per cent. Despite this careful summary, it is very likely that future statistics—where the Coffey technic of ureter implantation into the bowel is more carefully carried out—will show a great improvement. In Papin's statistics, he studied eighty-one cases of ureter implantation into the bowel, in which forty-eight patients died. Judging from this report and my own experience to date, transplantation of the

* A patient of Pawlik whose ureters were transplanted into the vagina which had been converted into a reservoir by a plastic operation.

ureters into the skin of the iliac regions seems to be, at the present moment, the most satisfactory method of disposing of the urine

In addition to the mortality, a serious objection to transplantation of the ureters into the intestine as the first step, is to be found in the fact that every total cystectomy starts as an exploratory operation, and if one has transplanted the ureters into the intestine as the first step, one has committed one's self to a total cystectomy which at the second operation may be found to be unnecessary. Federoff encountered this serious mischance in a physician on whom he operated †. The cystoscopic picture, the palpatory findings and the cystographic studies preoperatively usually make clear to the surgeon the necessity of doing a total cystectomy, but the final decision is rarely reached until the abdomen is opened and the bladder palpated from within the abdomen or inspected and palpated through a cystotomy incision.

Another objection to a preliminary implantation of the ureters into the bowel is to be found in the frequency with which infection develops in these ureters as usually one or both are dilated, atonic and very difficult to anastomose and, therefore, prone to an ascending infection. A large number of cases—many more than have been published—in which the ureters have been transplanted into the bowel with the idea of doing a secondary total cystectomy, have succumbed from this operation, in fact, in the series just quoted from Federoff's clinic, three cases out of the twelve mentioned in his paper, died as the result of ureter implantation before the total cystectomy could be undertaken ‡. This mortality, it seems to me, is much too high if total cystectomy is to be proposed to patients suffering from infiltrating growths at the neck of the bladder.

In the eight cases described in this paper, there was one operative death, and in this patient the ureters were obliquely implanted into the sigmoid, one kidney was atrophic, and the kidney on which the patient was living became infected through its dilated ureter and the patient died with an acute pyelonephritis. In the remaining seven cases, the total cystectomy was followed by immediate implantation of the ureters in the skin, in the iliac fossæ where the ureters were intubated with catheters or tubes, depending upon the size of the ureters. Both the first case with implantation of the ureters into the bowel and the seven cases of implantation of the ureters in the skin, were done in one step, and only one patient (the first case) in this series of eight, died as the result of the operation.

The operation of total cystectomy is not particularly difficult. It can readily be done through a simple mid-line suprapubic incision, preferably extraperitoneally though there is no objection to opening the peritoneum to determine whether the peritoneum overlying the posterior wall of the bladder is involved or not and whether any visceral metastases are present. If it is involved, it should be left attached to the bladder wall, and the peritoneum

† At the second step, he opened the bladder and found it normal, the suspected carcinomatous ulcer (due to radium) having healed.

‡ v. Scheele, three deaths in seventeen cases following first step.

on either side united so as to close off the abdominal cavity. Extra cross-cuts into the rectus muscles are absolutely superfluous, and any increase in the incision by resection of the symphysis is to be condemned. On opening the abdomen (in the Trendelenburg position), one should carefully palpate the bladder to confirm the previous diagnosis as one usually can recognize the infiltration corresponding to the neoplasm. If one is in doubt concerning the palpatory findings, the bladder ought to be opened and inspected and palpated from within. At times it may be necessary to remove specimens for immediate microscopic examination § before condemning the patient to a total cystectomy. The bladder can be readily mobilized, dissecting the peritoneum laterally and tying the various vesical arteries and veins. As the bladder is delivered extraperitoneally over the symphysis, the seminal vesicles and ureters are brought into view. The vasa on either side are doubly tied as they cross the ureters, and cut between, and the ureters are temporarily ligated as close to the bladder as is feasible, and cut across below the temporary ligatures which are applied to prevent spilling of possibly infected urine into the wound. The cut-off ureters are allowed to stay *in situ* until the prostate is well delivered, and to control bleeding from the plexuses of the prostate, heavy gut or silk sutures are introduced on either side, having made a pedicle of the prostate very similar to the cervix in supravaginal hysterectomies. The section is then made proximal to the prostatic transfixion sutures with the electric cautery, and the bladder with the upper end of the prostate and seminal vesicles attached is removed in one piece, care being taken not to spill any of the cancerous tissue in the wound. If there is any doubt as to the extent of the prostatic involvement and one wishes to remove the prostate down to the membranous urethra, it may be necessary to make a secondary perineal incision and cut across the membranous urethra before delivering the bladder and prostate. In some cases where there was doubt as to the prostatic infiltration, numerous radium seeds have been introduced into the cut surfaces of the prostate. In one case where a large metastatic gland was surrounding the iliac vessels at the bifurcation of the internal and external iliac arteries which could not be dissected free, radium seeds were introduced into this gland as well. After removing the bladder and as much of the prostate as seems indicated, the ligatures on the ureter ends are grasped, and the ureters are dissected free retroperitoneally so that they can be readily implanted through a gridiron incision near the anterior-superior spine without any tension. In doing this, the peritoneal fold must be pushed upward to avoid carrying the ureter intraperitoneally to the parietes. The ureters usually have to be freed three to four inches when they can be readily brought out beyond the level of the skin and attached with two silk stitches to the skin, then the temporary catgut ligatures are removed, the ureters are intubated with the proper sized catheters or tubes, and a silk thread is tied about the end of the ureter and its contained tube, about one-half to three-quarter inch of the ureter projecting beyond the skin. A small wick of iodoform

§ Pre-operative cystoscopic specimens usually make this superfluous

gauze is placed on either side of the ureter and the two tiny skin incisions are partly closed and covered with vaseline dressings. To destroy any implants that may have been spilt the median wound and its large recesses are carefully bathed in alcohol, the patient being lowered to the horizontal position. After five minutes' exposure to the destructive action of the alcohol, *the abdominal median working incision is closed in layers with adequate drainage down to the prostate*.

This is the technic that I have used in the last seven cases without any mortality. The main objection that I see is to be found in the fact that the patients have to wear a urinal to collect the urine from the two kidneys as both ureters have to be permanently intubated. It would be a great advance if after the patients had completely recovered and one were convinced that the carcinoma had been completely eradicated, one could secondarily transplant the ureters from the skin into the bowel. Up to date, this highly desirable solution of the problem presented by these cases has not been tried by me, and I doubt whether a satisfactory anastomosis of this sort is feasible as these ureters regularly—if not dilated at the time of the first operation—become dilated as the result of their primary disposition in the skin. Pyelonephritis with destruction of the kidney parenchyma has been a very infrequent accident in ureters treated by implantation in the skin. It has occurred, however, when the ureters have not been adequately separated retroperitoneally, which frequently causes some kinking of the ureters and makes for difficulties in passing catheters or tubes from the skin up to the kidney pelves. At times this difficulty can be overcome by using filiform bougies attached to Phillip's catheters, and after the removal of the Phillip's catheters, one rarely has any trouble in introducing fair-sized rubber drainage tubes. In only one of the seven cases did such difficulties arise while the patient was recovering from the total cystectomy, and in one other case—two years or so after discharge from the hospital—there was some difficulty owing to traumatism to the ureter and peri-ureteritis in introducing a tube up one of the ureters. In this latter patient a nephrostomy had to be done to save the kidney which was apparently obstructed by peri-ureteral exudate. In the other five cases there were no serious kidney infections, although in all cases, owing to the tube's presence in the ureter and pelvis, a certain amount of purulent discharge was present in the drainage from the kidneys. To reduce this to a minimum, the patient's kidneys and ureters are washed out once or twice a week with a mild antiseptic solution—such as acriflavine 1:4000—and the urine is kept as sterile as possible with urotropin and acid sodium phosphate. Dietary measures and various acidifiers may have to be used as otherwise the tubes may become incrustated with phosphates, and in one case where this happened, a small presumably phosphatic calculus developed in the renal pelvis. In my cases, as well as in the experience of Papin, the function of these kidneys remains satisfactory, and repeated tests with indigocarmine, and phthalein, as well as studies of the blood chemistry, fail to show any marked functional depreciation.

In the eight cases reported in the appendix to this paper, there was one death—a mortality of 12.5 per cent. In the last seven cases in which the operation was done by the extraperitoneal procedure with ureter implantation into the skin, there were no deaths. The patient that died, died in the hospital ten days following the operation with infection of his left kidney due to implantation of the ureters into the sigmoid. Of the seven cases that survived, one lived five years (Case II), one lived for nine months (Case III), Case IV with the leiomyosarcoma lived over two months. Cases V, VI, VII and VIII are alive. Case V is alive four years, Case VI is alive one and one-half years, Case VII is alive seven months, Case VIII is alive six months. The full details of these cases will be reported at the end of this paper.

All my patients have been males, and the technic which I have described is applicable to this sex. Federoff has attempted total cystectomy in females and has modified the technic of total removal of the bladder by beginning with an extirpation of the female urethra, which is tied off after it has been dissected free up to the neck of the bladder. Thus allows him to remove the bladder secondarily from above with a closed-off complete female urethra and prevents spilling of the malignant cells from the neck of the bladder into the peri-urethral tissues. At the same time, it makes for more radical extirpation of these growths as they tend to involve the proximal urethra as well as the neck of the bladder.

From this brief review of my personal experience, it must be evident that the mortality of extraperitoneal removal of the bladder with the adjacent prostate is not prohibitive and that the operation can be done in one step with implantation of the ureters into the skin without undue risk to the kidney's integrity, and, moreover, even though the patients have to wear an apparatus for the collection of their urine, they are relieved of their original painful condition, rendered fairly comfortable, well able to get about, and even to work and earn a livelihood.

CASE I—Total cystectomy for extensive infiltrating carcinoma of the bladder, intraperitoneal implantation of ureters into sigmoid. Death ten days after operation. Autopsy showed both ureters dilated, left kidney pyonephrosis, right kidney atrophic with dilated pelvis, urinary fistula to sigmoid.

M. B., male, thirty-five years of age. Six months previous to admission patient had painless hematuria and was treated for papillomata of the bladder by a urologist. As the treatment by electrocoagulation had not been satisfactory, patient was admitted to Mount Sinai Hospital in August, 1911.

At cystoscopy, he was found to have four rather solid-looking flat papillary growths in the anterior bladder wall. The adjacent bladder wall was oedematous. The tumors were treated with the monopolar current and rapidly melted away. On re-examination, the growths had failed to respond satisfactorily, having recurred at once though they were thoroughly and completely cauterized. Specimens removed showed an alveolar arrangement of cells, characteristic of carcinoma.

October 18, 1911, having consented to operation, it was planned to do a resection. On exposing the bladder transperitoneally, it was found to be firm and infiltrated throughout except on the left side of the fundus near the posterior wall. The bladder was opened through this soft and not involved area and palpated, and as the whole organ was dif-

fusely infiltrated, a total cystectomy was decided upon. The opening in the bladder was packed with gauze, and the peritoneal cavity widely exposed in the Trendelenburg position. The peritoneum in Douglas was cut through transversely exposing the vas deferentia, which were tied and cut. Both ureters were exposed. Temporary ligatures thrown around the proximal ends. The left ureter was cut close to the bladder whereas the right, which was involved in disease, was cut one and a half inches from the bladder. The various blood vessels going to the bladder were tied on either side. In this way, the bladder covered with its posterior peritoneal covering was completely freed down to the prostate where the venous plexuses were ligated. After transfixion, the prostate was cut across with the Paquelin cautery. This allowed of the removal of the bladder, vesicles and upper part of the prostate. Then the ureters were liberated retroperitoneally and brought out through stab wounds in the posterior peritoneum and drawn into the sigmoid through a longitudinal band of the sigmoid. The ureters were pulled through the small openings in this band and attached with chromic-gut traction sutures. Lembert silk sutures were applied externally bringing together the peritoneum over the ureters as in an oblique Witzel operation. Peritoneum from Douglas's pouch was attached over the ureter anastomoses, the ureters being placed one above the other at a distance of two inches. The defect in the pelvis was closed over almost completely by using the lower sigmoid peritoneum. Cigarette drain placed in lower angle of wound and abdominal wall closed in layers.

Following this extensive operation, patient apparently was doing well. On the seventh day there was some urinary leakage through the wound, and sixty to eighty ounces were passing through the rectum. About this time the left kidney region became painful and the patient had a chill and rise in temperature. His condition gradually deteriorated, and ten days after the operation (the left kidney infection being progressive) the patient died.

At autopsy, there was no evidence of carcinoma, the ureters were dilated, the left kidney pyonephrotic, the right kidney atrophic, there was a urinary leakage from the ureter-sigmoid anastomosis.

Comment ||—In this patient, the moderate-sized papillary growths which presented on the mucous membrane of the bladder masked a most extensive infiltrating carcinoma. The response to the high frequency current was unsatisfactory, and the microscopic examination of the tissue led to the absolute diagnosis of carcinoma. At operation, nothing short of a total cystectomy would have been of any avail. The transperitoneal excision of the bladder was performed with a sigmoid implantation of both ureters. The right kidney was atrophic as a result of either the bladder condition or some previous disease, whereas the left kidney, on which the patient was apparently living, became infected, and a moderate leak occurred at the point of anastomosis of this ureter with the sigmoid, and as a result of the severe infection of the left kidney, patient died.

*CASE II—Extensive infiltrating carcinoma of posterior wall, trigone and neck of bladder. Abdomino-perineal prostatocystectomy through an extraperitoneal approach. Section of the membranous urethra through a perineal incision, and implantation of each ureter in the skin through a gridiron incision in the iliac fossæ. Satisfactory recovery. Patient continued in good health with both ureters intubated with small rubber tubes until his death five years after the operation. At autopsy, he had a hydro-ureter and hydronephrosis on both sides with a local carcinomatous deposit surrounding the right iliac vessels and ureter.**

|| This is the only case of transperitoneal total cystectomy in this series.

* Already published in technical supplement in *Urological and Cutaneous Review*, vol. III, p. 4, 1915.

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S R, male, fifty-eight years of age Trouble began in September, 1914, with frequency of urination associated with pain, and one attack of hematuria

January 26, 1915, cystoscopy showed bullous oedema around the posterior circumference of the neck of the bladder with extensive tumor formation on the posterior wall Rectal examination showed a slightly enlarged prostate and in median line just below junction of prostate and of bladder a small stony hard mass, another somewhat hard mass in the position of the right seminal vesicle

Pre-operative Diagnosis—Malignant growth of prostate and neck of bladder

January 27, 1915, abdomino-perineal prostatocystectomy extraperitoneally Bladder was exposed extraperitoneally To confirm the diagnosis of malignancy, the bladder neck was palpated and found indurated To make doubly sure, a small opening was made in the bladder and the interior palpated Hard infiltrating masses were felt in the posterior wall running down to the neck Bladder incision was closed, and as no iliac glandular involvement was detected, a typical extirpation of the bladder was done, and the membranous urethra was cut through after making a perineal incision The left ureter was found dilated whereas the right was normal The bladder and prostate with seminal vesicles and perivesical fat were removed in one piece The two ureters were brought out through the abdominal wall and attached with a couple of sutures so that they projected beyond the level of the skin about one-half inch To relieve all tension on the ureters, they had previously been liberated for three to



FIG 1—Case II showing extensive involvement of the bladder down to the neck with removal of the bladder and prostate and posterior urethra in one piece Anterior view

four inches retroperitoneally Following their attachment to the skin, a No 6 fr catheter was introduced into the right ureter, and a small drainage tube was introduced into the dilated left ureter Median incision was closed in layers, drainage at lower angle

Kidneys drained satisfactorily through the ureters, patient making an uneventful recovery, and functional test on February 18, 1915, showed 25 per cent phthalein on the right side and 12 per cent on the left

By March 8, 1915, wounds were almost completely healed and the projecting ends of the ureters had sloughed away making healthy looking mucocutaneous fistulas The rubber tubes were changed regularly, and the pelvis and ureters were washed out several times each week

On March 27, 1915, the patient was discharged wearing a urinal into which both ureter tubes emptied, a small-sized rubber drainage tube having been introduced a few weeks after the operation into the right ureter in place of the original ureter catheter as this ureter had gradually dilated adequately

Specimen removed at operation showed a diffusely infiltrating tumor in the trigone and paratrigoal regions extending submucously over a considerable distance. There were several prominent hard nodules of carcinoma low down in the mid-line at the neck of the bladder as well as lateral to trigone. In the vertex of the bladder were numerous further masses of carcinoma which varied in size from a split-pea to large lima beans. The prostate proper seemed uninvolved.

Pathological Diagnosis—Infiltrating papillary carcinoma

Following discharge from the hospital, patient was regularly observed in the dispensary. Subsequently, he entered the Montefiore Home.

April 17, 1916, patient was in excellent health and was shown at the G U Section of the Academy of Medicine.

November, 1919, he was still in excellent health, almost five years after the operation.

In January, 1920, patient died at the age of sixty-three.

Post-mortem examination revealed a local carcinomatous deposit in the right pelvis, chronic pulmonary tuberculosis, and a recent tuberculous broncho-pneumonia with miliary tuberculosis in the right middle lobe.

Comment—In this patient, a very extensive infiltrating growth involving the trigone both at the neck of the bladder and at the ureteral regions, was removed by total cystectomy and prostatectomy by the combined operation. The ureters were attached to the skin in both iliac fossæ and intubated. The patient was made comfortable and lived five years without any great annoyance, and finally died of a flaring up of an old tuberculosis of his lungs. Autopsy showed that there was a quiescent carcinomatous focus in his right pelvis.

*CASE III—Total cystectomy for extensive carcinoma involving base and neck of bladder, partial prostatectomy, implantation of the ureters in the skin of iliac fossæ. Satisfactory recovery from operation. Death nine and one-half months after operation. No autopsy.***

W. C., male, sixty-two years of age, admitted to Mount Sinai Hospital May 11, 1915, giving a history of eight months of urinary trouble, frequency, pain and hematuria. General condition poor. Urine contained albumin, red cells and granular casts.

Cystoscopy showed a papillary growth of left wall, base and neck of bladder with extensive œdema, picture typical of carcinoma. By rectal palpation definite induration could be felt in the base of the bladder reaching down to the prostate.

Pre-operative Diagnosis—Infiltrating papillary carcinoma of bladder involving neck, possibly also adjacent prostate.

May 15, 1915—A complete extraperitoneal cystectomy and partial prostatectomy for carcinoma of the neck of the bladder was performed, implantation of ureters in skin. Operation was done through a typical suprapubic median incision. Exploratory palpation confirmed the presence of indurated carcinoma as seen cystoscopically. The bladder was freed, vessels on either side being tied on either pelvis wall with three or four ligatures. The right ureter was exposed and found to be normal, whereas the left ureter was much dilated. After separating the bladder with attached seminal vesicles and perivesical fat down to prostate, the latter was separated from its bed, making a pedicle from the prostate, and two heavy silk transfexion sutures were passed through the prostate and tied on either side. This allowed of a bloodless section through the prostate proximal to the silk ligatures. The bladder and two-thirds of prostate were then delivered. The ureters were attached to the skin in the iliac fossæ near the anterior

** Already published in technical supplement in *Urological and Cutaneous Review*, vol. III, No. 4, 1915.

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superior spines, and a catheter was introduced into each ureter. The median incision was closed in layers with adequate drainage at lower angle. Despite the patient's poor condition, he stood the operation very well.

Pathological Diagnosis—Infiltrating carcinoma

The post-operative course was satisfactory except for some temporary leakage alongside the small catheters in the ureters. After the ureters had dilated, rubber tubes were introduced and the leakage ceased almost completely.

On June 29, 1915, the right kidney secretion showed many clumped white cells, an occasional red cell, urea 8 per cent, phthalein in two hours 75 per cent. The left kidney showed urea 15 per cent, many non-clumped white cells, no red cells, phthalein in two hours 105 per cent.

Patient was discharged from the hospital with tubes in his ureters but he allowed them to fall out and to remain out of the ureters and had to be readmitted in November, 1915. His general condition was poor. There were no signs of metastases or local recurrences. He was comfortable and in no distress. Subsequently he was admitted to Montefiore where he died the end of February, 1916. No definite tumor masses could be recognized, the pelvis being free. There was a suggestion of metastasis in the inguinal glands. At Montefiore the patient's general condition gradually declined up to his death.

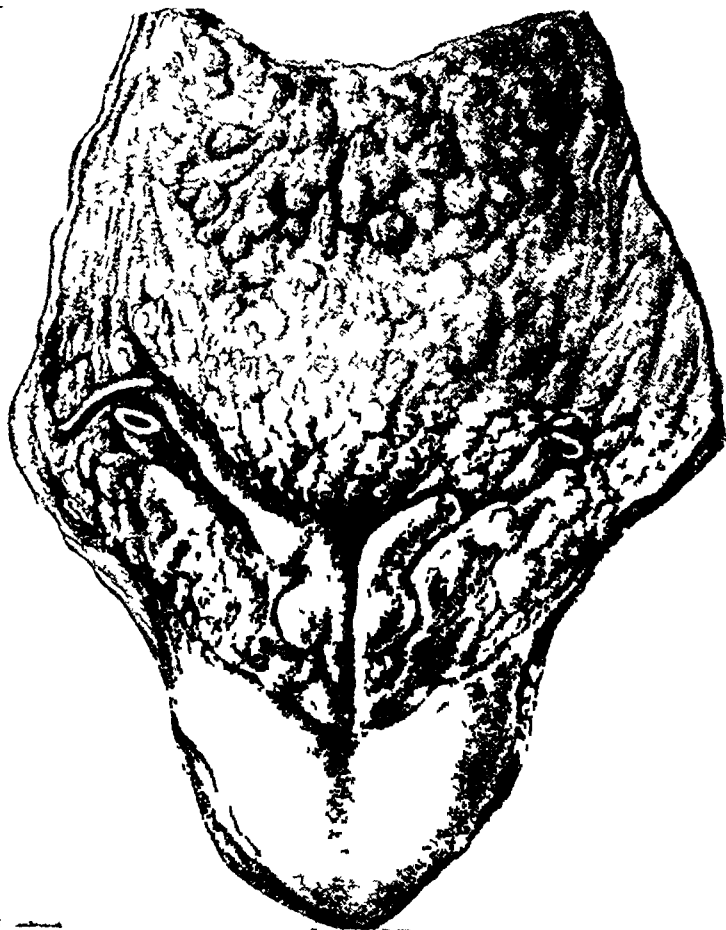


FIG. 2—Case II, showing the prostate, seminal vesicles and posterior aspect of the bladder removed in one piece.

Comment—This patient was sixty-two years of age at the time of operation and the poorest risk that has been submitted to such extensive operative procedure. Nevertheless he stood the operation well and was rendered comfortable for nine months or more, until his death.

CASE IV—Total cystectomy for extensive infiltrating leiomyosarcoma of the bladder. Discharged six weeks after operation with wound closed, ureters draining well, a large dose of radium having been applied to the stump of prostate. Seven weeks following discharge, local recurrence of sarcoma at lower angle of wound, and subsequent death.

L. G., male, forty-nine years of age, admitted to Mount Sinai Hospital October 11, 1919, complaining of hematuria which had recurred on and off during the last year. He had been treated previously for bladder trouble in 1914-1915. In 1918 he passed clots of blood.

At cystoscopic examination, it was difficult to enter the bladder. There was four ounces of residual urine, and an extensive necrotic, papillary looking neoplasm was seen on the left lateral and anterior walls. By rectum, a hard nodular infiltrating tumor could be felt coming down close to prostate. Specimens removed suggested a malignant papillary growth.

In view of the extent of the growth, it was considered very likely that a total cystectomy would be indicated and a written consent ‡ was obtained from the patient.



FIG 3.—Case II showing two tubes running to pelvis connected by a 'Y' tube and emptying into an improvised urinal.

an adult fist, infiltrating all layers of the bladder wall down to the neck, the right wall of the bladder being spared.

The convalescence from this operation was rather stormy. The exploratory opening of the peritoneum which had been sewed, tore open, and a small loop of intestine and omentum prolapsed but was easily replaced without any peritonitis developing. The ureter catheters were changed on the tenth day. On the twelfth day, No. 10 rubber tubes were introduced into the two ureters, and a large dose of radium was applied to the prostate for ten hours. On November 30, 1919, the patient was out of bed, the wound granulating slowly. Toward the end of December a nodule appeared in the wound which was excised and which proved to be metastatic leiomyosarcoma. At this operation there was a secondary suture of the old wound which healed satisfactorily.

The patient went home January 12, 1920, with the wound closed, but as he had difficulty in taking care of himself, he returned to the hospital in February, 1920, with a rapidly growing sarcoma in the lower angle of the wound. His general health was

November 14, 1919, the bladder was exposed and felt to be infiltrated on the left lateral, posterior and anterior walls all the way down to the prostate. In view of the age of the patient and the extent of the disease, it was decided to proceed with a total cystectomy rather than to stop at a suprapubic cystostomy even though the blood chemistry showed a marked increase in all the nitrogenous constituents.

The unopened bladder was removed and the prostate was cut across with the cautery. The ureters were brought out in the iliac fossæ and intubated. The wound was bathed in alcohol. During the operation a small tear had been produced in the bladder with the escape of some necrotic tumor tissue and foul urine.

Microscopic report on the bladder was leiomyosarcoma, the tumor being as big as

‡ To avoid any legal complications, a written consent has regularly been obtained before operation on all these cases.

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much worse than on his discharge from the hospital, and the patient died February 17, 1920

Comment—In this patient a rapidly growing sarcoma of the bladder wall was removed under the impression that we were dealing with a carcinoma. Despite the apparently complete removal of the bladder and retrovesical infiltrated fat, it was impossible to eradicate the disease *in toto*, and though the patient made a comparatively good recovery from this most malignant type of tumor, a local recurrence developed which ended fatally, a little more than two months after the total cystectomy and partial prostatectomy

CASE V—Total cystectomy and partial prostatectomy for multiple papillomata and papillary carcinomata with infiltration in the bladder wall involving the neck, right ureter region and left wall bladder, implantation of the ureters in the skin of the iliac fossa. Satisfactory recovery from operation despite post-operative pyelonephritis. Two and one-half years after operation, owing to difficulty in passing tubes up right ureter, a right nephrostomy had to be done, the left kidney continuing to drain well through the rubber tube but a small stone developed in the left kidney pelvis. The right kidney continued to drain well after the nephrostomy. March, 1929, patient alive and general condition excellent §§



FIG 4—Case V, showing extensive papillary carcinomata and multiple papillomata reaching into the neck of the bladder. The bladder wall is enormously thickened, giving the impression that the whole wall was infiltrated. This hypertrophy of the bladder wall was most misleading, and it is possible that in this case more conservative methods might have succeeded had we not been misled by the palpatory findings

J R, male, thirty-five years of age, admitted to Mount Sinai Hospital March 23, 1925, with a history of fifteen months intermittent hematuria. He had lost considerable weight.

Rectal examination disclosed a large indurated mass made up of bladder base and prostate which was definitely ballotable suggesting a neoplasm of both organs. Functional kidney tests were satisfactory. X-ray of the genito-urinary tract was negative. Cystogram showed an irregular bladder with the neck of the bladder raised above the symphysis. An air-cystogram showed an irregularity which suggested the presence of numerous tumors projecting into the bladder cavity.

Cystoscopy showed a contracted lumen holding three and one-half ounces. The bladder was full of papillary tumors, partly necrotic and partly fluffy. The left posterior wall seemed to be free from tumors. The cystoscopic diagnosis was papillary carcinoma with multiple tumors.

March 27, 1925, having obtained permission for a total cystectomy, the bladder, seminal vesicles and upper part of the prostate were removed in one piece. A typical median suprapubic approach was used. The peritoneum was opened and the viscera explored for metastases. As none were found, the peritoneum was closed and the bladder mobilized. The ureters were identified and separated from the large thickened bladder. On palpating the bladder, it felt like a most extensive infiltrating growth. The prostate was freed, transfixed near its apex, and cut across with a cautery. The bladder, upper half of the prostate and seminal vesicles were removed in one mass, and the ureters were freed and brought out extraperitoneally in the iliac fossæ where they were intubated. On opening the bladder after its removal it was found to consist of a very thick wall, the organ in places œdematous, and the seat of multiple large and small papillary growths, the largest situated near the right ureter.

The microscopic examination of one of these growths near the neck of the bladder, whose base was very hard, showed papillary carcinoma. Other tumors examined showed benign papilloma. The bladder wall itself, which felt most extensively infiltrated, showed no malignant infiltration, the thickening apparently having been due in part to the hypertrophy and in part to the œdema except at the site of the definite infiltrating papillary growth at the neck.

Post-operative pyelonephritis developed with chills, and colon bacilli temporarily appeared in the blood. Both ureters drained well, and following the transitory attacks of pyelonephritis on each side, the urine became fairly clear and the patient left the hospital with both ureters intubated.

Functional examination of the kidneys showed satisfactory output of phthalein and indigocarmine. Two rubber tubes were connected with a "Y" tube and these emptied into a urinal which the patient carried within his trousers. The patient was fairly comfortable. There was practically no leakage alongside the tubes. The patient continued to do well though there was some trouble from time to time in passing large 12-14 fr rubber tubes up the right ureter. As the result of repeated attempts, traumatism led to peri-ureteritis, and in the fall of 1927, as it was impossible to introduce even a catheter up the right ureter, to save the right kidney a right nephrostomy was done. There was some trouble in keeping the patient's urine acid, and though the tubes in his ureter and kidney had been repeatedly and regularly changed, phosphatic incrustations on the tube, despite urotropin and acidifiers, repeatedly developed.

By 1927 a small stone had formed in the left kidney pelvis which, however, caused no symptoms. Attempts to dissolve this stone with continuous irrigations of the left kidney pelvis—using hydrochloric acid as strong as 1/750—failed to dissolve this stone though it seemed (according to repeated X-rays) to diminish in size. The patient continued to drain well from his left kidney and from his right nephrostomy, and in March, 1929, he was last seen. His general health was excellent and there was no evidence of local or distant recurrences.

Comment—This comparatively young patient suggested pre-operatively and on the operating table a most extensive infiltration of the bladder wall. The bladder contained innumerable small and larger papillomata and a papillary carcinoma at the neck of the bladder. A typical extraperitoneal total cystectomy was done, and though two and one-half years after operation there was some serious difficulty in passing tubes up the right ureter which forced us to do a nephrostomy, the patient continues in excellent health without any signs of any recurrences, draining through his left ureter and from his right nephrostomy without any signs of any local or distant metastases.

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CASE VI—*Extensive infiltrating carcinoma of the bladder secondary to artificial cystitis. Right nephrectomy for calculous pyonephrosis, total cystectomy, partial prostatectomy, removal of lower end of right ureter with implantation of left ureter into skin. Radium seeds introduced into stump of prostate a few days after total cystectomy. Uneventful recovery. Tubes in left ureter changed every two to three weeks. Patient alive and working to date.*

M W, male, forty-four years of age. This patient was first seen in 1911 for chronic cystitis with contracted bladder. To escape military service an injection had been made into the bladder which led to a chronic cystitis. Under treatment at that time, symptoms of bladder irritation were much improved.

In 1917 he had pain in the right kidney region, hematuria and marked frequency. By April, 1927, symptoms had become more severe and he had lost twenty-five pounds. X-ray showed a large stone in the right kidney.

He was admitted to Mount Sinai Hospital in June, 1927, where cystoscopy showed a large carcinoma of the bladder and a right pyonephrosis. In view of the purulent discharge from the right kidney it was deemed advisable to remove the kidney first and subsequently take care of the bladder condition.

In August, 1927, the right kidney was removed by Dr. A. Hymann, and after recuperating from this operation, the patient returned to Mount Sinai Hospital.

Re-cystoscopy in October, 1927, showed the bladder full of foul bloody urine and numerous clots. Capacity was eight ounces, and there was an extensive growth of the posterior, right and left lateral walls. By rectum it was possible to detect a hard infiltrating mass occupying the whole bladder region. In view of the extensive growth which reached apparently well down to the neck of the bladder, the patient was told he would probably require a total cystectomy, to which he consented.

October 21, 1927, the bladder was exposed extraperitoneally and found to be extensively involved, the walls infiltrating well down over the prostate. The bladder was opened and as it was evidently impossible to remove the growth except by total cystectomy and partial prostatectomy, the bladder cavity was gently packed with gauze soaked in alcohol, the incision closed, and an extraperitoneal excision performed removing the bladder and upper two-thirds of the prostate and seminal vesicles as well as the lower end of the right ureter from the place where it had been sectioned during nephrectomy for right pyonephrosis. The whole mass was removed in one piece, and the left ureter was brought out without any tension through a gridiron incision in the left iliac fossa. The wound was soaked in alcohol and the ureter was intubated with a catheter.

Pathological examination showed a very extensive infiltrating papillary carcinoma

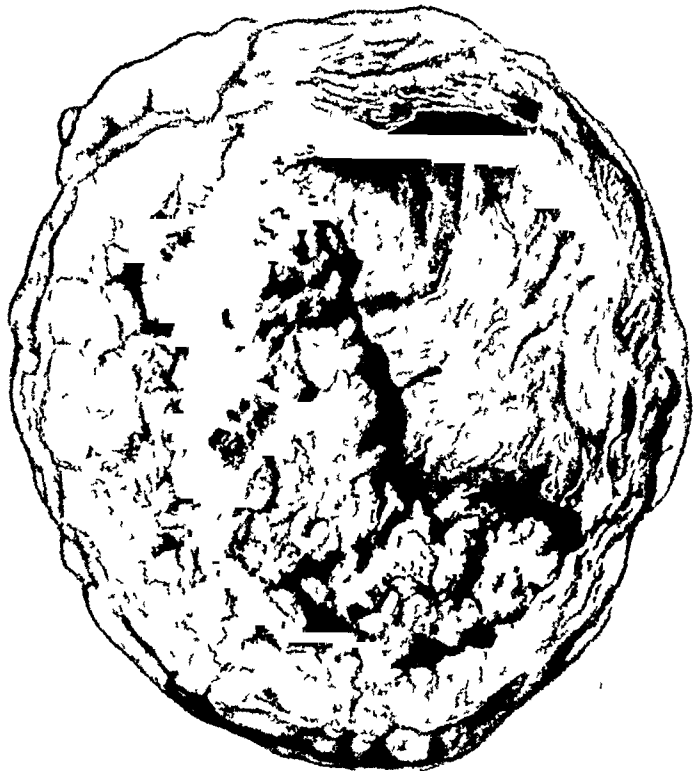


FIG. 5.—Case VI, showing extensive infiltrating papillary carcinoma involving the major part of the bladder with infiltration of the bladder wall, which in places is over one centimetre thick.

of the bladder with invasion of the capsule of the prostate. Only one seminal vesicle was attached to the specimen and it was not involved.

A few days following the above operation, a large number of radium seeds were introduced through the sinus down to the stump of the prostate. Patient made an uneventful recovery. Since the above operation his tube has worked very satisfactorily. The patient has remained perfectly well. His general health is excellent, and in March, 1929, patient was shown at a Joint Meeting of the Urological Society held in New York. Patient is well to date and able to be self-supporting.

Comment—This comparatively young man, as a result of chronic irritation induced years before, developed chronic cystitis which led to dilatation of his ureter on the right side and secondary calculous pyonephrosis as well as to an extensive infiltrating carcinoma of the bladder involving the adjacent prostate. Nothing short of a total extirpation of the bladder and prostate promised him anything, and following the operation the patient made an excellent convalescence so that at the present date—one year and seven months following the operation—the patient is self-supporting and in excellent condition, the left kidney (on which he is living) is draining satisfactorily through a ureter tube.

CASE VII—Extensive infiltrating papillary carcinoma of the bladder. Partial cystectomy of thickened bladder wall. Surface of mucous membrane showed three small papillary growths and the whole bladder was much thickened. Microscopic report showed diffuse infiltration of the bladder wall. Eleven days after preliminary operation, total cystectomy and partial prostatectomy with implantation of the ureters through two grid-iron incisions in the iliac fossæ. During the post-operative course, some difficulty introducing catheters into the ureters which led to attacks of pyelonephritis. After the ureters had dilated, rubber tubes were easily introduced, ureters easily taking 12-14 fr size. Patient is well and general condition is excellent to date.

I R, male, fifty-five years of age. Patient had been treated on and off for eighteen years for hematuria caused by a papilloma of bladder.

Under high frequency treatment tumors were readily destroyed but the patient was not adequately controlled, and in October, 1928, his bladder showed necrotic papillomata surrounding the left ureter region reaching down toward the sphincter involving the trigone and the left wall of the bladder. By rectum, no definite infiltration could be felt, and cystogram showed reflux up both ureters without any definite deformity of the bladder contour as well as no filling defect. X-ray of the lungs showed no metastasis.

October 11, 1928. *First operation*—Pre-operative cystoscopy under anæsthesia showed the same contracted bladder which bled easily, with flat necrotic papillary masses as above. The left ureter orifice was open and the tumor reached close to this as well as within a half centimetre of the right ureter. At the neck of the bladder there were also definite tumor areas covered with exudate. By rectum, under anæsthesia, a definite mass could be felt in the base of the bladder reaching above the trigone suggesting an infiltrating tumor.

No consent to total cystectomy had been obtained though the question of the advisability of doing such an operation was discussed with the family physician.

At operation, bladder was exposed suprapubically. It was very adherent. The whole posterior wall felt thickened. The peritoneal cavity was opened and explored for metastases. None were found but an inflammatory omental mass was felt attached just behind the bladder. Perhaps this was part of the induration felt by digital examination through the rectum. The peritoneum was closed and the bladder freed, and then opened with an electric needle. The whole posterior wall felt much thickened and œdematous with hard

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and very small papillary irregularities, in other places, superficial ulcerations with incrustation. No definite tumor could be detected otherwise. The whole picture suggested a proliferative, ulcerative cystitis with infiltration of the bladder wall. A large section was removed from the posterior bladder wall for microscopic examination. At the conclusion of the operation, owing to the doubtful findings, it was deemed fortunate that we had not discussed total cystectomy with the patient and proceeded at the first step in doing a total cystectomy.

The patient did well after this operation though he ran some temperature, owing to the infected condition of his bladder and some perivesical inflammation.

The microscopic report of the specimen from the posterior wall of the bladder, which had been removed at operation, showed a rapidly growing diffuse infiltration of the whole wall with carcinoma.

The situation was then laid before the family. It was evident that nothing but a total cystectomy could remove the extensive disease in the bladder, and having obtained consent, on October 22, 1928, a total cystectomy and partial prostatectomy with transplantation of the ureters to the iliac fossæ was performed. This was carried out in the face of an open bladder with perivesical infection, and even though the patient was running some temperature.

The tissues about the bladder were more or less infiltrated. The peritoneum was rigid, making the exposure of the floor of the pelvis particularly difficult. The bladder incision made at the first operation which had been closed tore open and further infected contents spilled into the pelvic cavity. The ureters were bound down by periureteritis. The left ureter was twice normal size, the right ureter was about normal size. They were freed for about 5 inches retroperitoneally and then swung outward above the structures of the cord, and after cutting through the transfixed prostate, the ureters were brought out through gridiron incisions and intubated with No. 6 fr catheters, the ureters being attached to the skin with silk, and the projecting ends of the ureters tied around to the ureter catheters with another piece of silk. The seminal vesicles were not removed with the bladder and upper half of prostate. Patient stood the operation very well and both ureter catheters were draining nicely. The central wound was closed with adequate drainage.

Two days after the operation there was a rise in temperature preceded by a chill and tenderness over the kidneys. The chills repeated themselves a number of times, and as the catheters began to swell, the drainage was less satisfactory and new catheters had to be introduced. Whenever catheters became occluded there was a rise in temperature. At times in changing these catheters during the first couple of weeks, the introduction of new catheters was most difficult. To dilate the ureters, filiform bougies of the Phillip's type were introduced into the pelves allowing the filiform end to curl up into the pelvis, attaching No. 10 silk catheters to same.

By November 19, 1928, it was possible to introduce on each side No. 12 fr rubber catheters with multiple holes. Subsequently, No. 14 fr rubber tubes were easily introduced and no more difficulty encountered.

On December 24, 1928, the patient was draining 122 ounces from the kidneys in twenty-four hours. His urine had come back to almost normal. The patient was up and about having been discharged from the hospital a week earlier. There was occasionally some discharge from the suprapubic incision which may have been from the prostatic stump, which was slow in healing over.

A recent last report from the patient shows his general health is excellent, he has lost no weight, his tubes are changed every two to three weeks, there is still slight drainage from the lower end of the median incision.

Comment—This patient, who had been treated on and off for eighteen years for papilloma of the bladder, developed malignancy which infiltrated

his whole bladder wall with comparatively slight mucous membrane involvement. It was originally decided that a complete cystectomy might be necessary but at exploratory operation, the slight involvement of the mucous membrane of the bladder suggested that a mistake had been made in the interpretation of the case. When the pathological report of an extensive infiltrating carcinoma (based on a large specimen excised from the posterior wall) came in, the question of total cystectomy was again raised, and with the consent of the family, this operation was done to give the patient, who

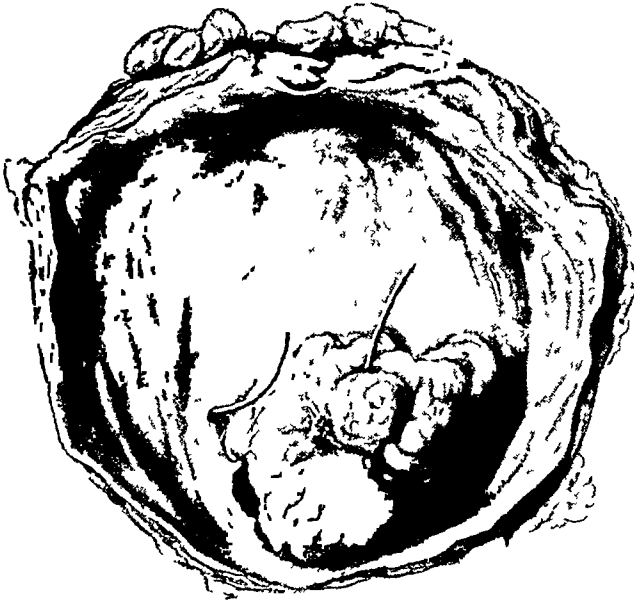


FIG. 6.—Case VIII showing papillary and solid carcinoma invading the neck of the bladder involving the left ureter and encroaching on the right, the whole trigone involved in the neoplasm.

otherwise was in perfect health, relief from distress and a possible chance of cure. Eleven days after the first operation, the second operation—total cystectomy and partial prostatectomy—was done. The patient made a satisfactory convalescence except for repeated attacks of pyelonephritis caused by poor drainage from the ureter catheters. As soon as the ureters were sufficiently large to admit of fair-sized rubber tubes, this condition was controlled and the patient was discharged to

his home in excellent condition. The patient to date remains well except for a slight discharge through a sinus which apparently leads down to his prostate.

CASE VIII—Extensive papillary infiltrating carcinoma involving the trigone, the ureter on one side and encroaching upon the ureter on the other side, also reaching down to the neck of the bladder. Total cystectomy and partial prostatectomy with implantation of the ureters in the skin of the iliac fossæ. A large metastatic gland at the bifurcation of the iliac vessels on the right side which could not be removed. Numerous radium seeds introduced into this gland as well as into the stump of the prostate. Uneventful recovery. Patient discharged from the hospital three months after admission with both ureters intubated with rubber tubes, doing very well, and has remained well to date.

A S., male, fifty-six years of age, admitted November 17, 1928, with a history of one year dysuria, frequency and hematuria. Last three weeks symptoms have been more severe and there has been pain in both kidney regions radiating down along ureters. During the day patient voids every half hour to one hour, and five times or more at night.

Cystoscopy without anæsthesia was unsatisfactory as patient's bladder was small and bled easily. A large solid and partly papillary growth was seen on the left wall extending into the trigone. It was more or less covered with phosphates. A large

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piece of the growth broke away and was extruded when patient squeezed against the cystoscopic sheath

Under caudal anaesthesia, second cystoscopy made. Tumor was found to extend to the sphincter region covering the left ureter and reaching almost to the right ureter. It was partly solid and partly papillary, the solid portions were definitely sessile. In addition there was a prostatic enlargement, adenomatous in type. Bimanual examination showed a definite mass above the prostate with infiltration of the bladder wall on the left side.

Specimens removed during cystoscopy were reported as medullary carcinoma.

Patient's general condition was fair. Blood chemistry showed 25 milligrams urea. A consent for total cystectomy was obtained prior to operation.

November 30, 1928, with a diagnosis of extensive infiltrating carcinoma in the positions just mentioned, a total cystectomy and partial prostatectomy was carried out. After exposing the bladder extraperitoneally and packing the wound, the bladder was opened to explore. It was found that the tumor was too extensive to permit of a local resection, that the neck was involved with an infiltrating growth from the right side anteriorly to the left side posteriorly, that the left anterior, lateral and posterior walls were infiltrated through the trigone past the left ureter orifice. The bladder was packed with alcohol soaked gauze and the incision temporarily closed with heavy silk stitches. The bladder and prostate

were mobilized, the latter transfixed, and the prostate cut across with a cautery. The ureters were brought out in the iliac fossae. In the right pelvic region at the bifurcation of the iliac vessels, a gland as large as a walnut containing metastatic carcinoma was encountered. As this could not be separated from its intimate attachment to the vessels, radium seeds were introduced into it, each containing two and one-half millicuries. In addition radium seeds were introduced into the stump of the prostate. The ureters were intubated with ordinary large ureter catheters, and the wound closed with drainage down to the prostate.

The patient made an uneventful convalescence. His phthalein output was repeatedly studied and each kidney delivered between 40 and 50 per cent.

By December 16, 1928, the ureters had dilated up sufficiently to allow the introduc-



FIG 7—Case VII, showing patient with two rubber tubes in ureters coming out of the iliac fossae, united by a "Y" tube and emptying into an ordinary urinary catheter attached to the left leg.

tion of No 12 fr rubber catheters These were easily introduced, there being no obstruction in the ureters

December 26, 1928, the blood urea dropped to 15 milligrams

January 28, 1929, patient had a mild attack of pyelonephritis which, however, did not disturb the kidney function

February 2, 1929, the lower angle of the wound was still discharging a small amount of pus, apparently from the stump of the prostate where radium needles had been inserted

May, 1929, patient has been regularly attending to the ureter tubes, having them changed every two to three weeks Patient is still in excellent health and is comfortable

Comment—This patient had an extensive infiltration of the trigone and neck of the bladder and had been suffering for over a year With total cystectomy, his life had been made bearable, he was able to get around, and even though the local metastases (which have been treated with radium implants) will probably eventually lead to his death, for the time being he has been made comfortable

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DISCUSSION DR WILLIAM E LOWER, of Cleveland, Ohio said that his experience with total cystectomy had not been very satisfactory He had done seven cases, with death in two before leaving the hospital Both of the fatal cases were severe and in both the kidneys were rather badly infected He did a two-stage operation in each case, first transplanting the ureters and later removing the bladder In one case the patient lived two and a half years During that time the man was able to go back to his work and economically presented a very good result

In another case the man is still living but he has a metastasis and is having severe pain in his thighs In the other cases the patients died from recurrence within a period of one and a half years

Lately, instead of doing this extensive operation in these cases he had gone back to treatment with the X-ray and radium About three or four years ago he felt that the X-ray treatment in these cases was not worth while He was just about to discontinue it when the department was reorganized and a clinician was put in charge of it instead of turning it over to the X-ray man who simply took X-ray pictures and who was much more interested in that phase than he was in the treatment The profession is now getting more encouraging results

Doctor Portmann, who has charge of the Department of X-ray Therapy, is called into consultation on these cases He examines the cases and treats them individually, just as a surgeon operates upon a case only after examina-

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tion He strictly individualizes his cases, that is, he does not follow out any particular routine The result is that in many cases the patients have been greatly relieved and have gone to work, and in several instances after two or three years are free from local recurrence He did not know whether he was going to have any cures in these cases, but he knew that economically these patients are put into a condition which could not be attained in any other way They are not annoyed by having to wear some type of urinal

Doctor Beei has been one of the pioneers in advancing the treatment of tumors of the urinary bladder It is possible that the technic that he describes may be the treatment to use in these desperate cases The speaker felt very much encouraged with the results he was getting with the X-ray, sometimes combined with radium One often does not get permission to do this extensive operation in the cases in which the disease is still in its early stages

DR ARNOLD SCHWYZER, of St Paul, Minn, said that in some cases of carcinoma of the bladder one can have rather long-lasting relief by energetic radium application He had seen this relief to last over two and a half years But there are conditions where radium does not give relief For instance, he mentioned a case which had been operated upon twice for multiple papillomata of the bladder The patient was most miserable There was a papillary carcinoma filling the whole bladder He was very glad to be able to do the excision of the bladder extraperitoneally

Doctor Beei has mentioned that there is comparatively rarely an involvement of the deeper parts of the bladder wall The neoplasm, especially of the papillary type, is in the mucosa, the submucosa and the superficial layers of the muscularis Thus one can make a subperitoneal excision of the bladder, the peritoneum being dissected away at times with remarkable ease

In this particular case he removed the bladder together with the whole prostate After freeing the bladder suprapubically he tilted the patient into the lithotomy position and through a perineal opening clamped the tissues below the prostate This enabled him to get the whole prostate out together with the bladder There was no undue bleeding The ends of the ureters had to be resected for about one inch A pseudo-bladder formed in the subperitoneal space and finally he had quite a good manner of draining the urine through the urethra into a urinal

DR EDWIN BEER (in closing the discussion) said that one must admit this is far from an ideal method of taking care of the patients, but, the situation is desperate and the patients suffer so much, and up to date no certain relief can be offered these patients except by total removal of the upper half of the prostate and the whole of the bladder If the ureters could be transplanted to the bowel with safety, without a much higher mortality than he had by transplanting into the skin, it would be a much more satisfactory method Anybody who has exposed ureters that have been blocked by growths at the neck of the bladder knows that the ureters are so large that a real good and safe anastomosis with the sigmoid is practically out of the question in the majority of the cases

CHRONIC CYSTIC MASTITIS OF THE DIFFUSE, NON-ENCAPSULATED, CYSTIC ADENOMATOUS TYPE *

(SHOTTY BREAST)

BY JOSEPH COLT BLOODGOOD, M D
OF BALTIMORE, MD

HISTORICAL —In December, 1906, in *Surgery, Gynecology and Obstetrics* (vol III, p 721) I made a report on this rare form of chronic cystic mastitis under the title "Senile Parenchymatous Hypertrophy" At that time it was known in the literature chiefly as Schimmelbusch's disease, Reclus's disease, diffuse papillary cystadenoma, and, by Warren, abnormal involution, or "cobblestone breast" All of the writers at that time, twenty-three years ago, were of the opinion that this was a precancerous lesion, and the probability of cancer being associated with it was at least 50 per cent Continuous study of this lesion of the breast in the Surgical Pathological Laboratory of the Johns Hopkins University and Hospital has forced upon us the conclusion that it is not a precancerous lesion, but cancer may develop in it just as it appears in the breast during pregnancy or during lactation, or in the breast of any female between the ages of twenty-five and the end of life Cancer in chronic cystic mastitis is an incident and not a consequence of this diffuse pathological process At the present time we do not know the etiological factors in cancer of the breast, nor those of chronic cystic mastitis

In November, 1921 (*Archives of Surgery*, vol III, p 445), in reporting, with ninety-one illustrations, our entire experience of 350 cases, there were exactly thirteen of the Schimmelbusch or Reclus type In fact, this type of diffuse, non-encapsulated papillary cystadenoma was the least frequent of the eight groups in which this disease naturally divided itself In the interval between 1906 and 1921, a period of fifteen years, I had become convinced that this type of chronic mastitis was not a precancerous lesion, and as a matter of fact, among the thirteen examples of which we had sections and tissue there was but one who died of cancer, and this was the only one in which the microscopic study revealed fully developed cancer I am inclined to the view now that this case was not cancer in diffuse, non-encapsulated papillary cystadenoma, but an example of acute carcinoma of the breast with a clinical picture of diffuse mastitis

The sections of these thirteen cases have been submitted to many pathologists, and the result has always been a difference of opinion on the twelve cases that we now look upon as benign, while in the one case—dead of cancer—all agreed that the microscopic picture was typical of cancer

The pathology of the first case observed at the Johns Hopkins in 1892 is recorded in Doctor Welch's own handwriting and describes the gross and microscopic picture of what we now know as diffuse papillary cystadenoma

* Read by title

In this case the glands were not involved, and the patient lived more than thirty years

In 1899 I had my first opportunity to palpate the breast and record the gross and microscopic pathology. The diagnosis then was papillary cystadenoma. Only the breast was removed, the patient was followed for more than ten years and there were no signs of recurrence. In 1901 I was able to study with my colleague, Dr John M T Finney, a most typical example of this shotty breast, and Mr Hoin has left us a painting of which Fig 3 is a photographic reproduction. The patient allowed Doctor Finney to remove but one breast. Our diagnosis was Schimmelbusch's disease with a small zone of cancer, shown in the illustration. This case was the basis of my report in 1906, five years later. We now know that the area of cancer in that breast was simply an atypical picture of papillary cystadenoma.

As our experience grew and we were able to follow this small group and restudy the pathology, we began to realize that this diffuse form of chronic cystic mastitis was apparently just as benign and no more of a pre-cancerous lesion than was the breast, the seat of single or multiple blue-

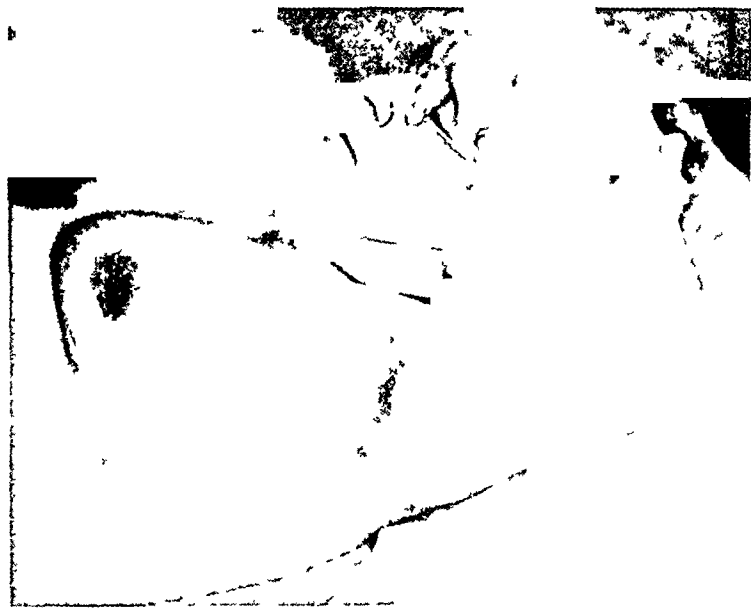


FIG 1—(Pathol No 30521) The proper position for inspection and palpation of breast. In this instance the inspection showed a clinically malignant tumor of the left breast, retraction of nipple and retraction and dimpling of skin. On palpation an indurated mass beneath nipple.

-domed cysts, or cysts of the galactocoele type, or those with dilated ducts beneath the nipple (the varicocoele tumor of the breast), or the "lumpy" breast, in which the definite and indefinite multiple areas present in both breasts were due to one or more minute cysts or dilated ducts. As a matter of fact chronic cystic mastitis is a very cosmopolitan disease—it presents a number of definite clinical pictures on palpation. Its gross appearance, when a single area or the entire breast is studied, varies with the changes in the parenchyma of the breast, and the varying amount of normal breast, stroma, fat, and the varying amounts and distribution of dilated ducts, minute cysts, big cysts, whether blue-domed or of the galactocoele type, large and small—usually small—intracystic papillomas, and areas of papillary cystadenoma. In addition, there may be distinct interstitial chronic mastitis with pressure destruction of the parenchyma like the senile breast. With rare exceptions the clinical picture of cystic mastitis is benign. In a small per cent the nipple may be retracted and now and then secondary infection

with its mastitis may produce dimpling of the skin, atrophy of the fat, and even redness and infiltration of the skin. It is the microscopic variants that have produced confusion with cancer. In my article in the *Archives of Surgery* for 1921, I have reproduced forty-nine different microscopic pictures showing changes from the normal breast through all the variants under the term lactating breast, senile breast, fibro-adenoma, intracanalicular fibro-adenoma, aberrant adenoma, irregular adenoma, cystic adenoma, small solid adenoma, solid adenoma microscopically suggesting cancer, chronic mastitis from compression of the wall of the big cyst resembling cancer, various forms of epithelium-lined cysts, of cysts with papilloma, of inclusions of papillary cystadenoma described by Ewing as of sweat gland origin, all types

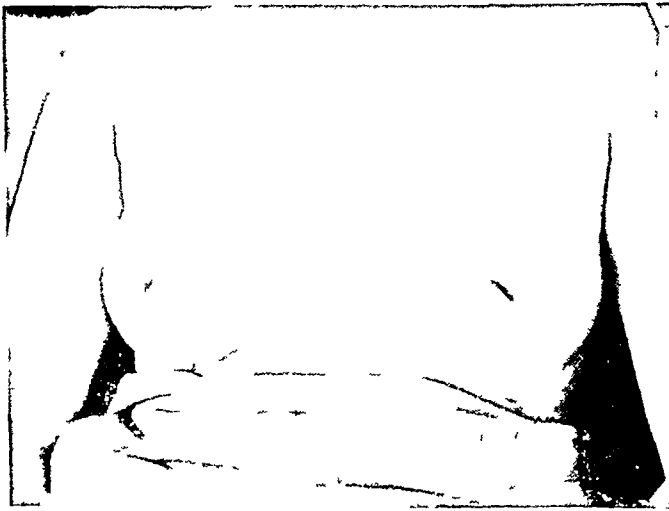


FIG. 2—(Pathol. No. 12586) Photograph of patient with shotty breast. Intermittent retraction of left nipple four years, permanent four months. Intermittent retraction of right nipple four months. Clinical diagnosis (Bloodgood) in 1912: Cancer in bilateral Schimmelbusch's disease. Complete operation on both sides. Microscopic study: Glands, no metastasis. Revised diagnosis: Diffuse non-encapsulated papillary cystadenoma. This patient lived free from recurrence fifteen years.

of dilatation of ducts with periductal inflammation, all the types of papillary cystadenoma, those distinctly benign and others suspicious of malignancy, the large solid duct adenoma which must be distinguished from comedo carcinoma, the combination of chronic mastitis and chronic cystic mastitis which is often associated with destruction of the basement membrane and invasion of the epithelial cells into the surrounding tissues.

Every term repeated here will be found in the literature of this breast disease. Since the second edition of Velpeau, with his description of the microscopic appearance of breast tumors up to the present time, pathologists have been finding difficulty in distinguishing in the microscopic picture between atypical epithelial or parenchymatous activities, from definite carcinoma, and through all these years one sees the terms adenocarcinoma, malignant adenoma, areas suspicious of malignancy, malignant intracystic papilloma.

After making this report in the *Archives* in 1921 I felt convinced that we were justified in being just as conservative with the Schimmelbusch and Reclus type of chronic cystic mastitis as with the definite single or multiple blue-domed cyst.

In November, 1922 (*Southern Medical Journal* vol. xv, p. 907), I made a report on the clinical picture of this diffuse type of chronic cystic mastitis and ventured to suggest the name "shotty" breast. In the one year since

the appearance of the contribution in the *Archives of Surgery* I had observed and recorded clinically six examples of the bilateral shotty breast, the clinical picture in which was apparently identical with five of the thirteen cases reported in the *Archives of Surgery* in 1921. Unfortunately in the remaining eight cases there was no note on the other breast. In one which proved to be malignant and died of cancer there is no positive evidence of involvement of the other breast. In a second case, one breast had been removed for cancer three years previously. Two cases that were examined later had definite shotty breasts, and letters from two others record disappearing tumors in the remaining breast. This suggests that in the majority the lesion was bilateral, but was not so recorded in the history.

The Increasing Prevalence of Chronic Cystic Mastitis in 1929—In the seven years since the report in 1922, I have more than one hundred cases of shotty breast in which about six have been subjected to operation for indications which will be discussed later. In three a cancerous lump was present in the breast, the seat of diffuse papillary cystadenoma.



FIG 4—(Pathol No 26046) Photograph of formalin specimen in 1920. This shows typical, diffuse, non encapsulated papillary cystadenoma and dilated ducts filled with thick, grumous material. I made a clinical diagnosis of bilateral shotty breast of the benign type, in 1920, and removed both breasts. The patient is living in 1929 without signs of any recurrence. Since this date I have not subjected to operation patients exhibiting this clinical picture, and have now a record of more than one hundred such cases. Photo by Herman Schapiro.

Up to 1900, in our records in the laboratory, the per cent of malignancy in breast tumors was 80, and the per cent of benign lesions of the breast in which operation was not performed was less than 1. In my own records today of the patients referred to me the per cent of benign lesions for which operation is not indicated, has increased from less than 1 to more than 65. Of the remaining 35 per cent in which, on account of a definite tumor, operation has been performed, about 17 per cent proved to be malignant and

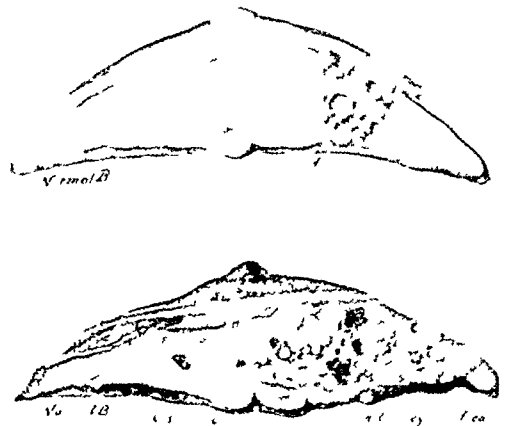


FIG 3—(Pathol No 3965) Diffuse, non encapsulated papillary cystadenoma. Clinically, bilateral shotty breasts, most marked in upper and outer quadrant of right breast. Removal of right breast only. Diagnosed cancer in 1901. Patient refused further operation, and lived twenty years. Photograph of painting by Mr. Horn made in 1901.

In the cases in which there was no definite lump, but only the clinical picture of bilateral shotty breast and in which operation was not considered indicated, there has developed as yet no example of malignant disease, and I have no evidence that these women run any more risk of cancer than any other woman of the same age.

The incidence of chronic cystic mastitis in all its groups increases rapidly when women report within a month, because attention to the breast has been called by pain, discharge from the nipple, lump or tumor, enlargement of one or both breasts.

18 per cent benign That is, the operative cases run about fifty-fifty This week in my clinic the benign operative cases of the breast were 75 per cent

The largest number of women who seek advice the moment they are warned by anything unusual in regard to the breast, come because of pain or a lump, or an enlargement When carefully studied, we find that the largest findings are lumpy breasts which are usually due to chronic cystic mastitis Shotty breasts are increasing in relative proportion, also dilated ducts beneath the nipple and the blue-domed cysts

Surgeons must be on the look-out, if their patients come from an enlightened community, for chronic cystic mastitis This is the most common lesion in breast cases in which the symptoms are of one month's duration or less



FIG 5—(Pathol No 3965) Section from specimen shown in Fig 3 In 1901 this was diagnosed *adenocarcinoma* The diagnosis was later changed to papillary cystadenoma

Clinicians and surgeons must learn the palpation or the so-called physical examination of the breast in women of all ages The moment one feels a definite single lump the condition of the remaining breast is of no value in the differential clinical diagnosis unless there are other definite lumps in the same or opposite breast With the rarest exceptions multiple definite lumps rule out malignancy, or if malignant, rule out curability If one therefore finds a single definite lump in the breast of a woman over twenty-five years of age

and, in addition, finds lumpy breasts or bilateral shotty breasts, or dilated ducts beneath the nipple, this must not influence the indication for operation any more than the signs of pregnancy or that the woman is nursing a child When there is a definite single lump with no signs of malignancy clinically, it must be explored and the differential diagnosis made while the patient is on the operating table, from a frozen section, best made without hardening of the tissue by boiling in formalin and with Terry's polychrome methylene-blue stain

The two greatest difficulties today in clinics in which the communities have been instructed on what to do the moment the attention is called to the breast, are First, palpation—find the definite lump, learn to recognize the shotty breast, the lumpy breast, the dilated ducts beneath the nipple, second, inspection—learn to recognize at once any irritation of the nipple which if overlooked may lead to Paget's cancer of the nipple and, third, if

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there is a definite lump, provide the operating room with a pathological team which will consist of one or more individuals who can make and stain a frozen section and properly interpret it through the microscope within five or ten minutes. The surgeon always has the safe rule to follow—to do the complete operation for malignancy if there is any doubt. My records show that clinicians and surgeons who have not had the experience to allow them to improve their sense of touch are overlooking definite lumps which are cancer in the early stage, and are postponing operation until the chances of a cure have been reduced from 70 to 20 per cent because of the involvement of the glands. On the other hand, at operation, the inability of their

pathological team to distinguish chronic cystic mastitis from cancer is increasing the number of women whose breast or breasts have been removed unnecessarily. This is the least dangerous mistake. Or, a doubtful tumor is removed and is sent somewhere for diagnosis, or is diagnosed in the clinic in from one to ten days, and then the complete operation is performed. If the tumor is really cancer the patient's chances of a cure are reduced by this delay. If the tumor is not cancer the woman loses her breast. If the tumor is

cancer and is diagnosed benign and the complete operation is therefore postponed until recurrence or is not performed at all, the woman loses her life. I have just seen in my clinic a woman who gives the following history. Six months ago a lump of a few weeks' duration was removed and *not* submitted to microscopic study. The operator diagnosed it a benign cyst. A tumor reformed near the scar. It was excised by another surgeon. The diagnosis was not rendered for two days, and then she had a complete operation with post-operative radiation. And now, she has a little lump in the remaining breast and is naturally anxious to have a different experience.

The Clinical Picture of Bilateral Shotty Breast—I have already noted that since my publication in 1922 I thought I had one hundred examples of bilateral shotty breast. Today there have been taken from my files among



FIG 6—(Pathol No 21770) An area of diffuse papillary cystadenoma in the wall of a blue domed cyst excised by me in 1916, and there is no recurrence in this breast in 1929, thirteen years later. In the gross and under the microscope, this area differs very little from Fig 5. Remember, this breast, the seat of this disease, was left.

the benign lesions of the breast for which operation was not performed ninety-seven histories. The first is dated December 1, 1920, the last March 18, 1929. There are about fifteen cases not in their envelopes which are out for various reasons, such as letters to be answered, etc. So there are more than one hundred cases.

In 1923 I find eighteen histories of this lesion. What a contrast with 1890 to 1921 when we could collect but about fifteen cases, of which thirteen were subjected either to the complete operation for cancer, or the complete removal of one or both breasts.

In rereading these histories and what I have published on this subject since 1921 I find that the clinical picture of the shotty breast remains

unchanged, but our knowledge of its existence and our ability to recognize it on palpation have greatly increased, and the records show that many individuals in the medical profession are able to interpret this group of chronic cystic mastitis as well as the other clinical groups.

Diffuse adenocystic or papillary-cyst-adenomatous type of chronic cystic mastitis, the disease known in the old literature as Schimmelbusch's or Reclus's disease and so clearly pictured in Fig 3 from a painting made by Horn, a colleague of

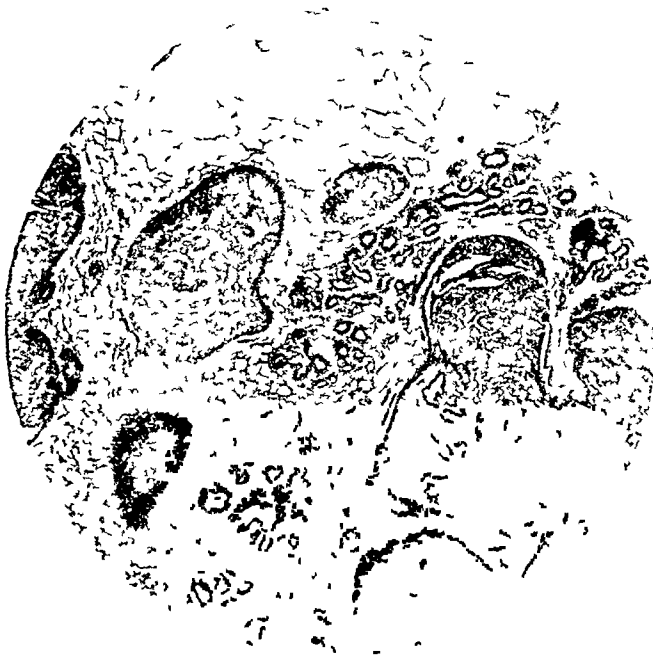


FIG 7—(Pathol No 26650). An area of large alveolar duct adenoma found in the wall of a blue domed cyst excised in 1920. No recurrence in 1929. Sections of this kind are common in Schimmelbusch's disease and are usually diagnosed carcinoma or adenocarcinoma or duct cancer.

Broedel, in 1901, can be recognized only on palpation. One breast may be larger than the other, but this asymmetry of the female breast is the rule rather than the exception, and any one of the diseases common to this breast may be present in either the smaller or the larger. But in the bilateral shotty breast, the larger breast is always the one in which the disease is further advanced. Discharge from the nipple is present in a small per cent of the cases. Retraction of the nipple of the intermittent type, unilateral or bilateral, is practically diagnostic, but I have observed it in less than 10 per cent of the cases. Discharge from the nipple is not diagnostic. Irritation of the nipple, of any type, seen on inspection, is not diagnostic. This may be present in any type of disease of the breast, benign or malignant. Dimpling or red skin suggesting malignancy is much less frequent than in the varicocele tumor

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of the nipple due to dilatation of the ducts. But in 1921, in the *Archives of Surgery*, I reproduced a colored illustration of patient and specimen, illustrating the clinical picture of cancer due to an infection of a cyst in Schimmelbusch's disease (Figs 30 and 31), and Fig 29 shows retraction of one nipple.

When one palpates the breast, as shown in Fig 1, and feels each breast with one hand and feels the periphery first and palpates as if playing the piano, the shotty condition of the breast tissue is brought out at once. The normal breast of a boy or girl at puberty approaches the shotty breast but the sense of palpation of the breast at puberty is one of firmness and distinct outline of the breast, while the shotty breast has this firmness and distinct outline in addition to the multiple minute shot-like nodules.

The firmness of the shotty breast is due to the increase of stroma and the distention of this stroma by the epithelial activity within the ducts and acini of the breast. The shot-like nodules are either epithelium-lined cysts, areas of papillary cystadenoma, or cysts filled with minute papilloma. Fig 3 from the painting by Horn shows a more or less normal breast to the left, while the hemisphere to the right illustrates the involved area. Fig 4 (Pathol No 26439) (*Archives*, Fig 26) is a photograph of a formalin specimen which, in the fresh, resembles Fig 3. It is

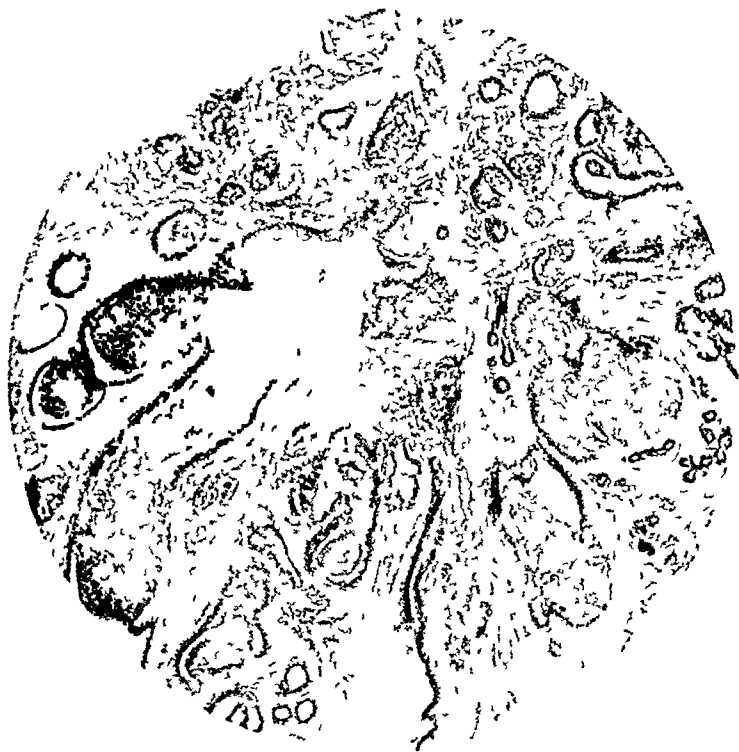


FIG 8—(Pathol No 1734) Diagnosed adenocarcinoma in 1897. The tumor, clinically benign, was first excised, then, after microscopic study, the complete operation for cancer was done. The glands showed no metastasis, and there were no signs of recurrence for sixteen years. Apparently Figs 7 and 8 are identical. In the case illustrated in Fig 7 the breast was not removed.

almost impossible to preserve the fresh appearance of the diffuse Schimmelbusch disease of the breast, or the rare encapsulated cystic adenoma.

The prominent feature in all the cases of which we have any record is the shotty condition of the breast and its increased firmness as compared with what we might look upon as the normal breast. The next feature is a distinct edge like the smooth, round edge of the liver. The next is such a firmness of the breast that when you pick it up, it curves and palpates like a saucer with a thick edge. Shotty and nodular, increased density or firmness, distinct edge, and saucer shape describe this diffuse form of chronic cystic mastitis, from its earliest to its latest sign.

Since we have made most careful notes of palpation of both breasts we have no record of this disease as being unilateral. The fault in my contribution of a few cases in 1906 and thirteen in 1921, was the absence, except in the recent cases, of any note on the opposite breast, or, if there was a note, the failure to appreciate the presence of this disease in its earlier stages. It is, therefore, safe to say that the shotty breast is bilateral. It may be more



FIG. 9.—(Pathol. No. 12451.) The operator felt that the tumor was benign. In the gross it was a non-encapsulated cystic adenoma. He removed the tumor with a zone of breast. The pathologist diagnosed it adenocarcinoma. The complete operation followed in one month. The glands showed no metastasis. The patient is well eighteen years later. There has been normal lactation in the remaining breast. About this section pathologists will disagree but in my experience, the patient will live.

advanced in one breast than in the other, for example, one breast may be simply shotty without a very definite edge and not yet saucer-like, while the other breast may have reached the saucer stage. The pathological process first appears in the upper and outer quadrant of both breasts. It always involves more than a quadrant and encroaches first more on the upper and inner quadrant than on the lower and outer. The lower and inner quadrant seems to be the last to become involved. Even over a fully developed zone there is no atrophy of the subcutaneous fat, or dimpling of the skin, except when there are signs of inflammation of the skin already noted. As a rule the nipple is free, although there may be congenital contraction of one or both nipples or, rarely, intermittent retraction. Unilateral retraction of the cancer type has been present in less than 3 per cent of the cases.

In my contributions in *Surgery, Gynecology and Obstetrics*, in 1906, I had only observed about four cases, and apparently I was interested chiefly in the pathology. I did not describe the clinical picture. In 1917, in a chapter on the breast, which I wrote for Binney's "Regional Surgery" although I know I was perfectly familiar, and had been for years, with this distinct shotty condition of the Schimmelbusch type of chronic cystic mastitis, I apparently did not describe it. But I did note (on page 606) that "We may palpate an indistinct tumor, a distinct circumscribed area, or a diffuse shot-like mass involving a quadrant, a hemisphere, or the entire breast." I have no record that in 1917 I as yet had become sufficiently impressed with

the distinct edge and the saucer shape, although, I am confident, it was present when I palpated the breast shown in Fig 3, in 1901, because this was the fully developed disease involving one quadrant, the upper and outer, of the larger breast, associated with a slight discharge from the nipple. The patient had been aware of this for four months, and she had had pain for six months.

Halsted described this sensation of fine shot-like masses in one of his earlier contributions, the reference to which I will add, if possible. I neglected to make reference to this in the monograph in the *Archives of Surgery* for 1921. In 1899, when I palpated this disease for the first time, I made the following note: "It involves a quadrant, and one could palpate an indurated area with many shot-like nodules and one larger cyst-like nodule." When I explored this area in 1899, thirty years ago, I found a blue-domed cyst with clear contents and a smooth wall, and when I divided the breast to remove this cyst, the surrounding breast had the appearance of a non-encapsulated cystic adenoma which I later saw in 1901 (Fig 3). I had already seen one in an encapsulated cystic adenoma. We were not using frozen sections then, but I looked upon the lesion as benign and removed the breast. The patient was followed for ten years, and I reported this as the benign type of senile parenchymatous hypertrophy in 1907 in a chapter on the female breast in Kelly and Noble's "Gynecology and Abdominal Surgery."

It was in 1901, twenty-eight years ago, that all of us in Halsted's clinic had the opportunity to palpate and to study, in the gross tissue and in sections, the fully developed Schimmelbusch's disease as pictured in Fig 3. The following is a quotation from our records: "On inspection, the outer hemisphere of the right breast was larger. On palpation, it was felt to be indurated like a 'caked' breast. The involved area had a distinct edge, and many shot-like nodules were felt. A brownish discharge could be expressed from the nipple." Therefore, between 1892 and 1901, we have a record of but three cases, while in 1923 we were able to palpate eighteen cases, and in 1928-1929 thirty cases.

In 1912 I recorded for the first time the lesion as bilateral and the intermittent retraction of both nipples.

The Clinical Picture of Other Groups of Chronic Cystic Mastitis—When I completed the clinical and pathological study of 350 cases of chronic cystic mastitis and published them in the *Archives of Surgery* for 1921, I could divide them into eight pathological groups. As a rule the clinical picture was fairly distinct for each group, and as a rule there was not much overlapping. I have no explanation to make for the development of 174 single blue-domed cysts and twenty-eight multiple blue-domed cysts and eight white- or gray-domed cysts of the galactoceles type. These 210 cases presented a pretty definite clinical picture. In 182 patients there was a single palpable tumor in one breast. In the great majority the tumor felt like a globe, smooth and

tense, was freely movable, gave the sensation of encapsulation, and often of fluctuation. As our experience grew, our sense of palpation more and more frequently recognized this single cystic tumor, and the diagnosis was confirmed by operation. In the eight years since this study we have only confirmed the clinical impressions recorded at that time. Now and then the cyst, when smaller than a ten-cent piece and buried in breast tissue, could not be recognized from other possible benign lesions, solid or cystic, or from the early stage of cancer. The benignancy of the single tumor was discovered only when the blue dome was exposed at the exploratory incision.

The remarkable feature of our records of these 182 cases of cysts is that in the early cases there is no note on the surrounding breast tissues or that in the other breast. Then we come to a period of careful palpation of both breasts, when we began to recognize the so-called "lumpy" breast with this single palpable tumor. Since 1921, our records show that in more than one-half of these cases both breasts are distinctly lumpy, and the single cyst is simply a larger cyst in a breast in which, when we divide the breast tissue to remove it, we find other minute blue-domed cysts, dilated ducts filled with all types of material, increased adenomatous areas, and every now and then a small, non-encapsulated zone, having the gross and microscopic appearance of non-encapsulated cystic adenoma, or Schimmelbusch's disease. That is, the common finding on palpation when one breast contains a blue-domed cyst or a cyst of the galactocoele type is the typical lumpy breast. Rarely do we find, on palpation, a distinct single or multiple tumor in Schimmelbusch's disease, and with equal rarity is there an association between a palpable cyst in one or both breasts and the varicocoele tumor of the breast due to the dilatation of the ducts beneath the nipple. There is no explanation for this, but the fact remains—and I called attention to this in December, 1906, twenty-three years ago in *Surgery, Gynecology and Obstetrics*—that we can divide chronic cystic mastitis into two great groups. In one, a large single or multiple cyst predominates in the gross appearance, in the other minute cysts or dilated ducts, or papillary-cystadenomatous areas. The proportion of the large cystic type to the non-cystic type is about as 210 is to 140.

In 1921 we had a record of twenty-eight multiple blue-domed cysts. The clinical picture was definite multiple tumors in one or both breasts. Since then this group has become very large, but operations are very rare, except the removal of one cyst to make the diagnosis positive.

This cystic disease of the breast was well known and described by Billroth and Velpeau, and later by Warren, of Boston. I am inclined to think that it is always bilateral, although the clinical picture and the follow-up have not the same proof as in the Schimmelbusch type or the dilated ducts beneath the nipple. But when the single cyst is removed from one breast and the patients are followed, there is more apt to be recurrence or the appearance of a second cyst in the opposite breast, and when we observe definite multiple cysts they are more common in one breast than in both breasts, and in our

recent studies with our finer developed sense of palpation we generally make out and record that these single or multiple definite tumors appear in breasts that are distinctly lumpy. Nevertheless, even today, if one palpates a single definite tumor, it is not safe to make a diagnosis of chronic cystic mastitis and postpone operation, even if both breasts are lumpy or shotty, or there are distinct dilated ducts beneath the nipple. But when a woman has been operated upon and the tumor is a definite cyst in chronic cystic mastitis and a new tumor appears in the same or in the other breast, it seems perfectly safe to give it a chance to disappear.

In 1921, among the 350 cases of chronic cystic mastitis there are fifty-six, or about 20 per cent, in which there was not a single or multiple tumor like a cyst, nor a dilated duct beneath the nipple, nor the shotty breast of Reclus's disease. As a matter of fact, this is rather an indefinite group in which the complete operation for cancer or the removal of both breasts has been performed by inexperienced surgeons or on incorrect pathological diagnosis. The majority of these fifty-six cases were, clinically, lumpy breasts which we now recognize and do not subject to operation. In a few of these lumpy breasts, before the removal of the breast, or the operation for cancer, one palpable area had been excised and submitted for microscopic diagnosis, and the removal of the breast or the cancer operation had been performed because of a diagnosis of malignancy or suspected malignancy. Fewer and fewer of these cases, I am glad to record, are being subjected to operation in the clinic, or sent to the laboratory from outside sources. The lumpy breast is much more common than the shotty breast. In 1921 they were as fifty-six to thirteen, in 1929 the relative number of lumpy breast has increased. The greatest difficulty in this group is when one lump is a little more distinct than any other and perhaps has been localized by the patient herself, with and without the guiding sign of localized pain or tenderness. Such lumps should be explored, and often it is difficult, with the frozen section or any other kind of microscopic section, to distinguish a non-encapsulated area of senile breast or old fibro-adenoma, or chronic cystic mastitis, or chronic mastitis, or residual latent lactation mastitis, from early cancer. Frequently in these areas the basement membrane so characteristic of normal parenchyma is absent, and the epithelial cells rest upon the stroma leading to a suspicion of malignancy or a diagnosis of definite cancer.

The varicocele tumor of the breast, with the rarest exceptions, is situated beneath the nipple and usually is bilateral. One may feel beneath one or both nipples one or more little dilated ducts which usually have the shape of an angle worm. Now and then pressure produces discharge from the nipple. The clinical picture of a non-encapsulated cystic adenoma is not any different from that of any other single tumor of the breast. The remarkable feature about this is that in the cases I reported in 1921—about eighteen in number—the complete operation for cancer was performed in every instance, either from frozen sections at the time of the operation, or, after longer intervals

of days or weeks during which time the permanent sections were repeatedly studied and often referred to one or more consulting pathologists

Clinical Picture of Other Diffuse Lesions of the Breast Which May Be Confused with the Shotty Breast, or Diffuse Chronic Cystic Mastitis of the Papillary Cystadenomatous Type—A quadrant a hemisphere, or the entire portion of a breast may be indurated and produce an enlargement which palpates somewhat like the shotty breast. I have previously discussed this especially in the *Boston Medical and Surgical Journal* and always bear these possibilities in mind when I palpate a diffuse lesion of the breast which should be included in the term mastitis or “caked” breast. What may be the etiological factor of this diffuse mastitis?

(1) Trauma with resultant ecchymosis and hematoma, leading to traumatic mastitis, (2) the caked breast of pyogenic mastitis of pregnancy or lactation, (3) tubercular mastitis, (4) metastatic mastitis which rarely occurs, but is seen after any infection like typhoid fever, pneumonia, or any other local or general infection, (5) the diffuse comedo adenocarcinoma, and (6) diffuse carcinoma, as a rule of the clinically acute type, and morphologically the cells are grade 4, that is the most malignant cancer cell

In the great majority of cases one can recognize the shotty breast of diffuse chronic cystic mastitis because it is bilateral, and because the palpation of numerous shot-like nodules rarely predominates in the picture of the other groups. The distinct edge may be present in the other groups, but the peculiar saucer shape assumed by the breast, when it is lifted off the chest wall by the edge, is never present in the other groups. The other forms of diffuse mastitis are as a rule unilateral. They are less apt to have a distinct edge and they are rarely shotty. However, I have seen every one of these seven groups of diffuse mastitis in which there was no change in the nipple, no dimpling or adherent skin, no atrophy of fat, no œdema of the areola—nothing on which to base the diagnosis except the palpation of an indurated mass occupying from a quadrant to the entire breast. In this small group the diagnosis can only be made from the frozen section at the exploratory incision. Up to the present time I have never explored a traumatic mastitis. The clinical picture immediately after the injury is so distinct. There is first, the definite, visible ecchymosis and the history of a recent injury. The palpable area of induration of the breast is, as a rule larger than the ecchymosis. Not a single case showed a definite edge, or the saucer shape, or the fine shotty nodules. As the color of the ecchymosis faded and disappeared, the diffuse mastitis broke up into multiple nodules, first definite, then indefinite, until finally all disappeared. As a rule the duration of the residual palpable area was three months. On a few occasions tissue removed from such breasts has been sent to the laboratory for diagnosis. The characteristic microscopic finding was hæmorrhage. I have only observed this in multiple intracystic papillomas. When we find the histological picture of chronic cystic mastitis there is no way to tell whether it was

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present before the injury or was the result of it. I have never observed a section of traumatic myositis to give the histological picture of mastitis.

The Caked Breast of Pyogenic Mastitis of Pregnancy and Lactation—Kilgore, in a recent number of the *Archives of Surgery*, from a study of the cases and records in the Surgical Pathological Laboratory of the Johns Hopkins University and Hospital, emphasizes the previously unknown fact that cancer is relatively frequent in these conditions of the breast, provided the patient is of the cancer age, and we must bear in mind that late marriages place more mothers in the cancer age. If the caked breast is bilateral, it is against malignancy, but it does not rule out tuberculosis. This type of mastitis has never impressed me as suggesting the shotty breast. However it is impossible, in the earliest stages, to distinguish the indurated area from cancer or tuberculosis. It has been my rule, in all cases of mastitis during pregnancy or lactation to explore at once, unless the area subsides or forms an abscess. In the latter event there is no difficulty with diagnosis, and the abscess is treated as any other abscess and drained. As a matter of fact, I have rarely seen such a case, but many histories record the diagnosis of mastitis during pregnancy or lactation in which the clinician, either because cancer was not considered or because there was no definite symptoms, waited until cancer developed. But in the past five years we rarely had an example of mastitis in pregnancy or lactation, because these women are under the care of the nursing or medical profession, and the nipples are kept clean.

Our histories show that the incidence of mastitis in the lactating breast has dropped from more than 20 to less than 1 per cent. This should impress upon everyone that a woman who has a caked breast in pregnancy or lactation today, runs a greater probability of cancer than ever before, and there should be no delay in exploring a frozen section.

Tubercular Mastitis—Remember, this may be bilateral. It is more frequent in pregnancy. It may involve half the breast before there is a sign of an abscess. It has no distinctive gross appearance before the stage of caseation. Microscopically, tuberculosis in lactation hypertrophy gives a picture closely resembling cancer. When you find a definite giant cell tubercle, you can rule out cancer, but when only lymphoid granulation tissue is seen mixed with lobules of lactating breast in which the basement membrane is destroyed by the inflammatory process and the morphology of the epithelial cell changed for the function of producing milk, the microscopic differentiation from cancer requires experience. In those years when tuberculosis of the breast came under observation with sinus or abscess, there was no difficulty in making a clinical diagnosis. Nevertheless, even in this group, I find a number of microscopic diagnoses of cancer, but today the patients with tubercular mastitis come under observation with an indurated mass in one or both breasts. When only one breast is involved, cancer must be ruled out. The presence of tuberculosis in an X-ray of the chest is evidence in favor of tuberculosis of the breast, but in the one case in which I was

influenced by such an X-ray picture to postpone operation, the lesion of the breast proved to be cancer

Metastatic Mastitis—I find I have notes on but a few cases. In none was there any difficulty in the diagnosis. The definite history of the previous infection which as a rule was grave, the fever and leucocytosis associated with the breast condition. In not all of the cases did the mastitis go on to suppuration.

Cancer Mastitis—It is interesting to record that the least malignant type of cancer of the breast and the most malignant, may begin as a diffuse area of induration, palpating like a caked breast, with the rapid involvement of a quadrant or more. The lesion is unilateral. None of the cases palpated by me have been shotty, although there is a distinct edge. None had the saucer shape. But many of these cases have been diagnosed mastitis, although the patients have been neither pregnant nor nursing, nor has there been a history of a recent injury or infection. The diagnosis of a non-malignant mastitis when the mass in the breast appears spontaneously without any history of the usual etiological factors, is a very dangerous one. In the past year three such cases have come under my observation in which such a diagnosis had been made, and all of them had been treated with the violet rays or sunlight.

I again urge my colleagues, who are interested in improving their expertness in palpating lesions of the breast, to go over carefully what records they have of these seven possible types which may produce an indurated mass in the breast, and I would sincerely appreciate notes on their cases, with the pathology and the results. In my experience chronic cystic mastitis of the diffuse adenocystic type is becoming more and more the predominant lesion, because more and more women are reporting at once for examination. The probabilities are that the incidence of cancer mastitis has always been small, and now, of course, is more so than ever. There is no doubt that tubercular mastitis is on the decline. Traumatic mastitis, from my records, is distinctly on the increase along with cystic mastitis.

Clinical Picture of Breast Lesions—I have in mind the reproduction, if possible, of illustrations picturing the normal breast and the different types of chronic cystic mastitis in somewhat diagrammatic form in which the gross lesion is seen through transparent skin, but I have had no opportunity to have these illustrations made as yet. The only way, however, to get a real picture of the varying pathological lesions is to palpate the breast, to make a diagram and record of what is felt and then, if operation is done, associate the gross and microscopic findings with the clinical record. When the entire breast is removed, one can make a whole microscopic section as advocated and practiced by Cheatle, of London, and as is being so well done by Wainwright, of Scranton, Pa., in this country. But I am confident that every one who reads this will agree with me that the clinical picture of breast lesions is changing, perhaps not so rapidly as in my own clinic, but rapidly enough to make diagnosis more and more difficult. To repeat, in Halsted's clinic,

up to 1900, more than 99 per cent of the women who came into the clinic had definite lumps of the type that should be operated upon. In my own clinic since 1925, less than 35 per cent have definite lumps in which operation is indicated, and the incidence of cancer in the operative group is fifty instead of eighty.

The more women are enlightened the greater will be the per cent of the cases in which operation is not indicated. The group of chronic cystic mastitis which is a disease that has a tendency to disappear, is observed less and less frequently in women who delay examination, and most frequently in lesions of one month's duration.

I have told my students in the past five years that most of the written records collected in the laboratory, on the palpation of breast tumors, are of little value today, because they record the clinical picture of a neglected tumor. The difficulty today is, first, to find the lump, second, to really recognize the lumpy breast, the shotty breast, and the dilated ducts beneath the nipple. There is no doubt that women are feeling lumps, whether single or multiple, much earlier than ever before, because in my experience in the past two years, I had the opportunity to palpate more single indefinite lumps than ever before, and at exploration to find cancer in its earliest stage more and more frequently.

Frozen Sections—I again call attention to the microscopic illustrations in the *Archives of Surgery* for 1921 and, to repeat, it is safer to do the complete operation if the pathologist is in doubt. Fortunately the number of women that will be mutilated will be relatively small. It is a dangerous procedure to explore a lump in the breast of any woman over forty without preparing the patient for the complete operation and without being prepared to make an immediate frozen section.

Gross Pathological Diagnosis of Breast Lesions—There are a few gross appearances remaining which are sufficiently distinct to allow one to be certain that the lesion is benign, even if the microscopic section is suspicious of malignancy. When the tumor proves to be a definite abscess, cancer can be ruled out, although the tubercular or non-tubercular mastitis may suggest malignancy in the frozen section. When one explores a definite tumor and finds a blue dome and, on nicking the dome, exposes clear or cloudy fluid, and on opening the cyst, the wall is smooth, there is no question as to the benign nature of the lesion. However, in the wall of this blue-domed cyst or in the surrounding breast, there may be present adenocystic types of chronic cystic mastitis difficult to differentiate from cancer. When I find such a microscopic picture around a blue-domed cyst, I am always conservative, but now and then, when I find them, without a definite blue-domed cyst I am apt to recommend the complete operation for cancer, because as yet the differential diagnosis between these atypical adenocystic changes in chronic cystic mastitis and cancer are so difficult to make that it is wiser, in the absence of a definite blue-domed cyst, to operate for cancer. We need a differential stain to make easier and more certain this differentiation. An

encapsulated solid tumor of the breast is benign. Even when sarcoma develops in the intracanalicular myxoma the definite capsule is lost. It is essential to learn to recognize encapsulation of breast tumors. Blood in a smooth-walled cyst, or in a cyst without a papilloma, means cancer. When the surgeon has a papillomatous cyst he should always bisect the base of the papilloma. If the papilloma has infiltrated through the cyst wall, it is malignant. Multiple cysts with papillomas are not necessarily malignant. Fully developed cancer in its earliest stages cannot be distinguished in the gross from a non-encapsulated adenoma or area of mastitis. We must no longer depend upon the gross appearance. We must depend upon frozen sections.

What Shall the Operator Do, When Pathologists and Frozen Sections Are Not Provided For in the Operating Room?—It is my opinion that this group of surgeons had better perform the complete operation for cancer when the palpable tumor is clinically malignant. They should only explore breast tumors when they are perfectly definite. They should excise the entire tumor with a zone of breast tissue, pack the wound with an alcohol sponge, put a towel on the left hand, place the tumor on the towel in the hollow of the hand, bisect the tumor. If it is a typical blue-domed cyst or an abscess or a distinctly encapsulated tumor, or a cyst with a papilloma, in which the papilloma has not infiltrated the wall of the cyst, remove no more than the tumor. In all other cases perform the complete operation for cancer.

When, however, the tumor is indefinite I believe, it would be better for such a patient to be referred to a surgical clinic equipped for frozen section diagnosis in the operating room, because the probabilities are that these tumors are not malignant. If they are they belong to the most curable group. Gross diagnosis as a rule is impossible, and frozen section diagnosis difficult. Operation in stages for the malignant tumor is dangerous.

SUMMARY AND CONCLUSIONS ON THE SHOTTY BREAST

In 1906 and in 1921, and again in 1929, I am attempting to make definite the clinical and pathological picture of diffuse chronic cystic mastitis of the papillary cystadenomatous type commonly known in the older literature as Schimmelbusch's or Reclus's disease and formerly (1906) called by me senile atypical parenchymatous hypertrophy. I believe that I am conservative and safe in again emphasizing that this is not a precancerous lesion any more than the lactating breast. But it may present microscopic pictures difficult to differentiate from cancer, and now that more and more women are coming immediately after the first symptoms, more and more breasts, the seat of chronic cystic mastitis of this and other types are being sacrificed, I am confident that if surgeons and their pathologists will give more attention to the study of chronic cystic mastitis, less and less women will be mutilated in our endeavor to persuade through education, more and more women to have their breasts examined the moment they feel a lump or pain or any other symptom which calls their attention to the breast. In order to give all

CHRONIC CYSTIC MASTITIS

women who may have a cancerous lump in the breast at least 70 per cent chances of a cure, we must bring them all under observation within a month. In probably 70 per cent of these cases any operation can be decided against by palpation alone. Of the 30 per cent in which the breast must be explored, in one-half or more the benignancy of the lesion can be recognized by a combination of gross inspection and immediate frozen section. Therefore, this surgical lesion is enough to justify a more comprehensive study of chronic cystic mastitis and the introduction of frozen sections in the operating room, and research for a differential stain.

THE SURGICAL TREATMENT OF DUODENAL ULCER

END-RESULTS OVER A TWENTY-FIVE YEAR PERIOD

By JOHN M T FINNEY, M D (By Invitation)

AND

EDWARD M HANRAHAN, JR, M D

OF BALTIMORE, MD

THE object of this paper is not to advocate any one surgical procedure as opposed to any other, nor is it to press the claims of surgical as against medical treatment of duodenal ulcer. It is rather an attempt, from a study of all the cases that have occurred in the surgical services of the Johns Hopkins and the Union Memorial hospitals during a twenty-five year period (1900-1925), to determine just what one is justified in promising a patient who consults him for duodenal ulcer, and also, which offers the better chance for relief or cure, medicine or surgery. Furthermore, for our own personal satisfaction, we have endeavored, by the same means, to secure information of value in helping us in the matter of the choice of operation, when it may be needed.

The true evaluation of any therapeutic procedure is possible only when compared with the natural history of the disease against which it is used. In order, therefore, to determine the therapeutic value of a surgical procedure, such as pyloroplasty or gastro-enterostomy in duodenal ulcer, we may well use two standards of comparison. The first is the result obtained following expectant or medical treatment alone, to be accepted, owing to obvious uncertainties, with some reservation, the second is the result following the use of other surgical procedures.

Inasmuch as the etiology and pathogenesis of duodenal ulcer are not yet clear, all forms of treatment, both medical and surgical, are based upon accumulated experience and, therefore, are largely empirical in character. Both medical and surgical procedures aim to relieve pain, to secure better drainage, to put the affected part at rest, to limit the amount of trauma by the passage of rough and irritating foods, to eliminate possible foci of infection elsewhere in the body.

The physician, as a rule, does not refer his patient to the surgeon as soon as the diagnosis of duodenal ulcer has been made, unless the diagnosis has been established by the occurrence of an acute complication, such as perforation, hæmorrhage, etc. The patient who comes to his physician because of periodic hunger pains, with their demoralizing effect upon his general morale, is of the class which chiefly interests us in this discussion. He does not present a surgical emergency. He is an individual who may or may not have a lesion of the duodenum which, if present and unoperated upon, may have to be nursed for a long time, possibly for the remainder of his life. The resulting disability may be slight, or it may be great, even

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to such an extent as to incapacitate him for his ordinary routine of living. Whether or not surgery offers this patient more than medical treatment is a question which interests doctor and patient alike, and whose answer we must find in the comparison of sufficiently large groups of cases which have been carefully studied and treated each way.

Unfortunately, for our purpose, many of the publications dealing with the medical treatment of ulcers make no differentiation between gastric and duodenal types. Most surgeons, however, feel that these two conditions present quite different problems and, therefore, should be dealt with differently.

Crohn states, "In general it may be safe to say that conservative medical treatment permanently cures 40 per cent of its cases. During the course of treatment, 1 or 2 per cent may die of hæmorrhage, and probably even a smaller percentage of perforation." In considering the general prognosis of gastroduodenal ulcer, he says "Death from hæmorrhage, perforation or malignant degeneration occurs infrequently, and then usually within the first few months or years. If a case remains rebellious to medical treatment, and uncured after several years of symptoms, danger of death from the ulcer or its complications is remote. But, the chance of healing with permanent cure from medical treatment also becomes less favorable with the passing years." On the other hand, surgery, according to its advocates, will cure 90 per cent of the operated cases which survive operation.

Crohn's studies of immediate and late results of medically treated duodenal ulceration agree in general with those reported by other observers. He finds that the immediate results are very good, namely, 86 per cent are apparently cured, only 14 per cent remaining unimproved. Most of the recurrences take place during the second six months, when 34 per cent of the apparently cured cases develop unfavorable symptoms. With succeeding years, new cases of recurrence are added, but no longer at the same rate of progression. Within four years, 50 per cent of the apparently cured cases will have relapsed. From this very general comparison, we must be impressed by the fact that, after deducting the operative mortality, the percentage of patients who are immediately benefited, following either medical or surgical treatment, is essentially the same, but, as the length of time following treatment increases, recurrences appear more frequently in the medically treated group.

The choice of treatment may well be based on the age, temperament and economic condition of the patient, and the duration and severity of the symptoms. The patient who is over forty who has had symptoms either constantly or even recurrently over a period of years, who, because of temperament or lack of means, is unable to follow the necessary dietary regimen, is more properly a candidate for surgery than the young man who has very recently developed signs of duodenal ulcer and whose occupation, means and temperament permit him to pursue a properly regulated and supervised course of medical treatment. If, after a fair trial of medical treat-

ment, the disease has not been controlled, then surgery would seem to be indicated

After consultation with our colleague, Dr Thomas R Brown, we have formulated the following as a list of valid indications for surgical intervention in duodenal ulcer, other things being equal. It would appear that this list of indications should satisfy both the physician and the surgeon

Perforation, organic obstruction, impaired motility, repeated hæmorrhages, persistent pain or discomfort, due to local peritonitis, perigastric or periduodenal adhesions, unrelieved pyloric spasm, chronicity, repeated failure to bring about relief by medical and dietetic means, assuming, of course, that the treatment and after-treatment have been wisely advised and conscientiously carried out, economic factors, importance of limiting the period of disability in working people, the possibility of malignant degeneration of gastric ulcer, as suggested by a gradually falling acid, persistent occult blood, slight lessening of appetite, strength, blood count, etc., the possibility that the ulcer may be secondary to, or its symptoms kept up by, disease of appendix or gall-bladder or both. This triad being relatively common, and, as a rule unamenable to the usual treatment of gastric or duodenal ulcer by medical or dietetic means is often brilliantly cured by the removal of diseased appendix or gall-bladder

Having reached the decision to operate, what type of operation offers the best chance of relief? There have been many procedures advocated from time to time. These, in general, include pyloroplasty, or gastro-enterostomy, either alone or combined with excision of the ulcer, sympathectomy, and partial gastrectomy. Appendectomy or cholecystectomy are often combined with these. Excision of the ulcer alone may occasionally be employed. The benefit through pyloroplasty is believed to result largely from relief of obstruction and the abolition of pylorospasm, with the consequent reduction in the emptying time together with the accompanying reduced gastric acidity. Gastro-enterostomy is also believed to reduce the pylorospasm. The amount of irritation from food is diminished by means of the short-circuiting and it is believed that reduction in gastric acidity may be favored through regurgitation of alkaline duodenal secretion and improved drainage.

Resection of large portions of the stomach wall has met with favor in many European and in a few American clinics. Its advocates believe that the resulting quantitative reduction in gastric acidity (which is due, not as originally stated, to the removal of the acid-bearing area, but to the removal of the stimulating factor, whatever that may be) diminishes the likelihood of subsequent gastrojejunal ulceration. Partial gastrectomy is a formidable procedure, even in the hands of the expert surgeon. Before we can accept it in place of pyloroplasty or gastro-enterostomy, we must be convinced that the state of health induced in the survivors is appreciably better than that following the simpler operations. Of this we are not as yet convinced, although it is true that in our small series of resections, the results have, so far, been excellent but the number is far too small from which to draw conclusions. The simpler operations have yielded almost as good results. If the main reason, as stated by some for partial gastrectomy is the endeavor to avoid subsequent gastrojejunal ulceration one should be convinced that

this complication occurs with such frequency as to constitute a grave objection to the operation of gastrojejunostomy as ordinarily performed. This has not been the experience of American surgeons as a whole, 5 per cent may be stated as a conservative estimate, although Lewisohn of New York believes that it may occur as frequently as in 33 per cent of all cases. Finally, it must not be forgotten that recurrent ulceration may follow partial gastrectomy.

The operation commonly known as "The Finney Pyloroplasty," first reported to this Association twenty-seven years ago, was a natural development from the Jaboulay gastro-duodenostomy. By extensive division of the pyloric ring, an enlarged gastric outlet is formed, the ultimate diameter of which is limited only by the diameter of the duodenum. One great advantage of this reconstruction is the temporary abolition of the action of the pyloric sphincter. Frequently, there is to be observed an effect similar to that produced by dilatation of the anal sphincter for fissure in ano, namely, relief of the distressing spasm, which so often accompanies it. In so far as gastric peristalsis permits, the stomach and the first portion of the duodenum are, by this procedure converted into a single organ whose outlet is the descending portion of the duodenum, and into which there is no obstruction to the regurgitation of the bile, pancreatic juice and duodenal secretion. In the course of this operation, it is quite possible to excise ulcers on either the anterior or posterior wall of the duodenum, without materially altering the customary incision.

By virtue of the fact that there is a potential space between the posterior surface of the duodenum and the posterior abdominal wall, to which it is loosely attached, the duodenum may, as a rule, be so freed that its mobility resembles that of the embryonic state. Then, and only then, may the anastomosis be made with entire absence of tension. As we have repeatedly pointed out, it is upon the thorough accomplishment of this mobilization that the success of pyloroplasty depends.

In 1927, we began a study of the late results following all operations which have been performed upon the stomach and duodenum in the Johns Hopkins and the Union Memorial hospitals, between the years 1900 and 1925. This study has been interesting in many ways. During that period a great increase in all types of gastric surgery has occurred, but the most spectacular increase has been in the number of operations for duodenal ulcer. For example, between 1900 and 1915, 50 per cent of all operations in our series were for gastric ulcer, 43 per cent for gastric cancer, 7 per cent for duodenal ulcer. Between 1920 and 1925, duodenal ulcer was the surgical diagnosis in 40 per cent, gastric cancer in 37 per cent, gastric ulcer in 22 per cent. We can offer no satisfactory explanation for this apparent increase in the incidence of duodenal ulcer. It is difficult, however, to believe that it is a real increase.

We believe that a period of at least two years should have elapsed before the late result of an operation for duodenal ulcer may be determined with any degree of assurance. Our study is based on the results noted in 380

consecutive patients who had been operated upon for duodenal ulcer. One-third of these (33.3 per cent) were between thirty and forty years of age at the time of operation, 70 per cent were under fifty years of age.

Our histories indicate that there is a marked difference in the proportionate distribution of gastric and duodenal disease in blacks and whites.

TABLE I

Results as Found in 1927, Following Gastro-enterostomy and Pyloroplasty for Duodenal Ulcer, Operated upon in the Johns Hopkins Hospital and the Union Memorial Hospital, between 1900 and 1925

Operation	Number of cases	Deaths within six months after operation	Not traced	New total	Living improved	Living unimproved	Died of causes related to original condition	Died of causes not related to original condition	Patients improved by the operation	Patients not improved by the operation
Gastro-enterostomy	96	16 (16.6 per cent)	15	65	54	4	2	5	59 (90.8 per cent)	6 (9.2 per cent)
Pyloroplasty	139	8 (5.8 per cent)	25	106	91	11	0	4	95 (89.6 per cent)	11 (10.4 per cent)

This same difference has recently been observed by Sturtevant and Shapiro. For example, 96.3 per cent of our duodenal ulcer patients were white, while for gastric cancer, this was decreased to 90.7 per cent. In our series, duodenal ulcer has occurred much more frequently in males than in females, 86.3 per cent as opposed to 13.7 per cent.

The operation most frequently employed was pyloroplasty. It has been the operation of choice, when conditions have permitted its performance, for the simple reason that we believe that it least disturbs the normal physiological relations, while affording relief to the distressing symptoms. This operation was performed upon 139 patients, fifty-two of whom were complicated by an additional operation, such as appendectomy or cholecystectomy. It should be stated that we make in every case a systematic survey of the abdomen and, at the same time, remove palpably diseased appendices or gall-bladders.

Gastro-enterostomy was done in ninety-six patients, in thirty-nine of whom an additional operation was performed. Therefore, in about 60 per cent of our series, conditions were found suitable for pyloroplasty. This may be taken as a fairly accurate index as to the proportion of cases in which this operation is deemed advisable.

Of ninety-six patients in whom gastro-enterostomy was performed, sixteen, or 16.6 per cent, died within six months of the operation. This seems an extraordinarily high mortality rate, but it may possibly be explained by the fact that we have included the first six months, rather than a short

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hospital stay as the operative interval. We have done this because mere recovery from the operation by no means necessarily constitutes a cure. Sufficient time must elapse before the result can be satisfactorily determined.

Of 139 patients in whom pyloroplasty was performed, eight, or 5.8 per cent, died during the first six months. The result in our series, then, would appear to indicate that the mortality during the first six months after opera-

TABLE II
Causes of Death within Six Months After Operation

Operation	Operative shock	Cardiac failure	Pulmonary complications	Obstruction	Embolus	Unexplained or unknown	Total
Gastro-enterostomy	2	1	1	11	1	0	16
Pyloroplasty	0	1	3	2	0	2	8

tion is nearly three times greater after gastro-enterostomy than after pyloroplasty. There were no immediate deaths following partial gastrectomy for duodenal ulcer in fifteen patients.

In all groups of our series large enough for statistical purposes, 15 to 20 per cent were unable to be traced following discharge from the hospital. Of sixty-four patients who survived the operative interval of six months, after gastro-enterostomy, fifty-four, or 84.3 per cent, were living and improved upward of two years after operation. This percentage very closely approximates that following pyloroplasty, 85.8 per cent. Four, or 6.2 per cent, were living, but unimproved following simple gastro-enterostomy, while eleven, or 10.3 per cent, were unimproved following pyloroplasty. But while 9.5 per cent of gastro-enterostomy cases died subsequent to the six months' period, only 3.7 per cent died subsequent to this period after pyloroplasty. Eleven of twelve patients traced following resection were living and improved. One was living but unimproved, while none had died.

Our figures, therefore, as do the figures of most observers, indicate that about 90 per cent of those who survive the usual surgical procedures are markedly benefited. But, in all fairness, we must remember that this high figure is reached only after an operative or immediate mortality of about 10 per cent for the entire surgical group. Again, if we start with two hundred patients and treat one hundred medically and one hundred surgically, the experience represented by our figures would indicate that after a sufficient interval (ten years) sixty-three of the latter would be living improved, five would be living unimproved, fourteen would have died, ten soon after operation and four some time subsequent to it, and seventeen will not be located. With fairly diligently pursued medical treatment, the one hundred cases not operated upon will doubtless show comparable results. There will be a higher percentage who are living unimproved, but we would not have had an operative mortality of 10 per cent. These figures seem to indicate that a patient with symptoms suggesting a duodenal ulcer, but who does not

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at the time suffer seriously from any of its complications, is not necessarily a candidate for immediate surgical treatment. If he lives in a community where reasonably good surgical attention may be secured, should he be advised to postpone operation until some complication intervenes, or until further pursuance of medical measures seems fruitless, or should he not? There would seem to be less chance of his developing a dangerous hæmorrhage or an acute perforation and dying from it, or from the emergency operation then demanded, than from the ordinary risk of operation under average conditions. We do not mean to imply that there is such a risk in the hands of a Mayo or a Moynihan, but we can do no more than point to the figures as given in our series, which is made up of the results of men who are, with few exceptions, in no sense to be considered as specialists in gastric surgery, but rather represent a cross section of surgical practice in general. It is from the standpoint of the average surgeon that we are speaking, and not that of the expert in gastric surgery.

As regards the type of operation, pyloroplasty has proved in this series to be a safer procedure than gastro-enterostomy. If in one hundred surgically treated patients, pyloroplasty has been performed, only eight would have died at the time of the follow-up, five immediately after operation, three subsequent to it. This is a more favorable showing than that of the combined surgical group.

Of the 380 cases of duodenal ulcer, thirty-one, or 8.2 per cent had perforated. Of these, 16 per cent died in the hospital, nine, 29 per cent, were not traced, fourteen, 45 per cent, were living and improved, one was living unimproved, two subsequently died. Our group of perforations is too small from which to draw more than inferential conclusions regarding the choice of operation.

We would emphasize the fact that the choice between medical and surgical treatment for uncomplicated duodenal ulcer will depend very largely on the mental, economic and social status of the patient. Unless unusual circumstances affect the decision, surgery should be postponed until time has shown that medical treatment is of little avail. Our study of 380 cases of duodenal ulcer treated surgically between 1900 and 1925 has shown that, while both gastro-enterostomy and pyloroplasty yield almost identical results in percentage of improvement among those who have survived the operation, the mortality, both immediate and subsequent, is lower after pyloroplasty, about three to one. Ninety per cent of these patients who survived operation, and were traced, were well or improved for periods of from two to twenty years.

In this study no account, of course, has been taken of the imponderable factors of physical and mental distress, loss of time from work due to rest treatment, starvation and other medical measures which interfere with the patient's activities, his ability to make a living or his enjoyment of life. It will be generally admitted, I think, that these factors loom larger under medical than under surgical treatment. The loss of time and money result-

TABLE III
Summary of Deaths Which Occurred within Six Months following Gastro-enterostomy

Case number	Sex	Age	Date of operation	Condition of patient	Condition found at operation	Operation	Result
1	F	48	Dec 9, 1912	Emergency ulcer (10) with hemorrhage and perforation	Peritonitis, perforation between gall-bladder (containing stones) and duodenum	Posterior gastro-enterostomy	Died shortly after operation Autopsy showed large gall-stone in lower ileum, beyond which was contracted gut
2	M	62	Feb 1, 1918	Ulcer history of long duration Chronic moderate pyloric obstruction	"Clucked" scarred area around pylorus and duodenum Adjacent lymph glands enlarged	Posterior gastro-enterostomy	Died day after operation
3	M	67	Dec 24, 1917	Ulcer history of long duration No severe complications	Ulcer on anterior wall of duodenum Impossible to mobilize duodenum	Posterior gastro-enterostomy	Died two days after operation Cardiac death
4	M	55	Mar 26, 1914	Abdominal symptoms for five years (believed to be months before operation)	Dense adhesions Scar in duodenum just beyond pylorus	Posterior gastro-enterostomy	Died suddenly seven days after operation Suggested embolus
5	M	36	Nov 6, 1919	Active ulcer history for six years No complications	Old ulcer low down on duodenum Many dense adhesions between intestine, gall bladder, duodenum and transverse colon	Posterior gastro-enterostomy	Obstructive symptoms on third day Wound infection Enterostomy on fifth day Died fifth day
6	M	54	Sept 25, 1925	Symptoms one year Increasingly active hemorrhage Pain	Ulcer at pylorus, adherent Recent inflammatory reaction	Posterior gastro-enterostomy	Obstruction seventh day Explored Edema of jejunum and its mesentery about stoma Anterior gastro-enterostomy performed Died that day
7	M	58	Oct 19, 1907	Symptoms for three years Loss of seventy pounds weight Frequent vomiting	Extremely stenosed pylorus with surrounding adhesions Dilated stomach	Posterior gastro-enterostomy	Obstruction—gastric tetany Gastro-enterostomy on eleventh day followed by death Autopsy Both openings patent Explantation of obstruction not clear

TABLE III—(Continued)
Summary of Deaths Which Occurred within Six Months following Gastro-enterostomy

Case number	Sex	Age	Date of operation	Condition of patient	Condition found at operation	Operation	Result
8	M	49	Dec 18, 1922	Gastro-intestinal symptoms leading to exploratory laparotomy September, 1921 Release of adhesions	Large indurated ulcer in duodenum Adhesions precluded any mobilization	Posterior gastro-enterostomy	Bronchopneumonia fourteenth day Died on
9	M	57	Apr 29, 1922	Long ulcer history, bleeding during previous year	Puckering and scarring on inner border of duodenum Adherent to pancreas	Posterior gastro-enterostomy	Obstruction Explored on fifteenth day Release of adhesions Died fifteenth day
10	M	58	Nov 27, 1914	Symptoms three years Obstructive symptoms six months Previous operation 1903—"Duodenoplasty"	Mass in duodenum Dense adhesions	Posterior gastro-enterostomy	Obstruction Explored fifteenth day Great induration around anastomosis Died nineteenth day
11	M	32	Feb 13, 1917	Intermittent history over nine years Anæmic and undernourished	Duodenal ulcer—2 cm Many adhesions Pylorus, duodenum, gall-bladder and transverse colon	Posterior gastro-enterostomy Appendectomy	Obstruction Explored nineteenth day Stoma patent Upper intestine collapsed Anterior gastro-enterostomy done below constricted small intestine Died twenty-first day
12	M	50	Oct 25, 1915	Several hæmorrhages over four years Recent pain	Indurated duodenal scarring with adhesions to colon and omentum	Posterior gastro-enterostomy	Obstruction On twenty-second day Explored Kink in jejunum below stoma freed Jejunostomy Closure of pylorus
13	M	58	Dec 23, 1924	Intermittent abdominal pain for years	Duodenal ulcer Anterior surface	Posterior gastro-enterostomy Resection duodenal ulcer	Obstruction Release of adhesions sixteenth day Gastrostomy and drainage, localized peritonitis twenty-first day Died twenty-sixth day

THE SURGICAL TREATMENT OF DUODENAL ULCER

Summary of Deaths Which Occurred within Six Months following Gastro-enterostomy

Case number	Sex	Age	Date of operation	Condition of patient	Condition found at operation	Operation	Result
14	M	51	May 2, 1913	Several years' history—Past six months hematemesis Loss weight Moderate anemia	Small mass in duodenum Thick adhesions binding duodenum posteriorly, and to the gall-bladder	Posterior gastro-enterostomy	Obstruction Tenth to thirteen days Explored Pylorus ligated Died thirty-fifth day
15	M	34	Mar 27, 1916	Three years Recent obstruction Poorly nourished Moderately anemic	Fairly large mass, on duodenal side of pylorus pancreas adhered to bladder	Posterior gastro-enterostomy	After three months developed signs of partial obstruction At operation, the duodenal mass was diminished in size, so that partial gastrectomy was done On fourth day following this operation, localized peritonitis was drained Died that day Survived original operation three months
16	M	43	Jan 7, 1925	Five years Several severe hemorrhages Moderately anemic	Ulcer on anterior surface of duodenum Duodenum posterior and could not be mobilized	Posterior gastro-enterostomy	Obstruction after seven days Operated upon fourteenth day Jejunostomy Died eighteenth day Edema of lungs

ing from long continued medical treatment will probably balance the expense of a surgical operation. But, on the other hand, one must not lose sight of the mental distress, the post-operative pain and discomfort and the inevitable mortality rate attendant upon surgical operations. No careful surgeon will, for a moment, lose sight of these possibilities.

Hence, in the final analysis, what are to be the determining factors in deciding between medical and surgical treatment or between one operative procedure and another? The conscientious physician and surgeon will carefully weigh all factors in the light of accumulated experience and attendant circumstances, and decide accordingly. He will not be unduly influenced by custom or rule of thumb, or even weight of authority. He will decide each individual case on its merits, not by generalization or by standardization. Every case presents a separate individual problem, the satisfactory solution of which depends upon the exercise of surgical judgment of a high order in selecting the operative procedure best adapted to the individual case which ability, in turn can only be acquired by giving due heed to the lessons that are to be learned from the open-minded study of one's end results.

In comparing the medical and surgical treatment of duodenal ulcer, it must be borne in mind that, as a matter of fact, the two are hardly comparable at all, since surgery usually begins after medicine has failed. The favorable cases will respond to medical measures, while surgery, as a rule, deals with those cases in which medicine has proved unavailing.

Again in this series, pyloroplasty, as the operation of choice, was done in the easier and more favorable cases while gastro-enterostomy was reserved for those cases in which, for some reason, pyloroplasty was not thought advisable—perhaps the more difficult cases. These two factors may help to explain the favorable results under medical treatment, and the rather high mortality rate after gastro-enterostomy in our particular series. In all fairness therefore, in attempting to compute relative mortality rates for different methods of treatment of duodenal ulcer, due allowance should be made for these and similar variable factors.

To Summarize—We believe that a study of this series of cases of duodenal ulcer, representing, as it does, a cross section of the surgery done by the average surgeon will warrant the following conclusions: (1) The immediate results obtained by either medical or surgical treatment are essentially the same, (2) the late results favor surgical treatment, inasmuch as 90 per cent of those patients who survived the first six months following either gastro-enterostomy or pyloroplasty were improved or cured by the operation, (3) pyloroplasty, in properly selected cases, is the operation of choice, by reason of the lower mortality within the first six months after operation.

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TABLE IV
Summary of Deaths Which Occurred After Six Months following Gastro-enterostomy

Case number	Sex	Age	Date of operation	Condition of patient	Condition found at operation	Operation	Result
17	M	42	June 1, 1916	Emergency — acute obstruction	Large hard indurated mass in duodenum apparently around an old ulcer	Posterior gastro-enterostomy	Died shortly after operation, on Feb 7, 1919, for sarcoma of psoas muscle Two years, seven months after gastro-enterostomy
18	M	43	Mar 27, 1922	Previous operation one year before. Ventral hernia. Pain chief symptom	Large egg-sized mass in posterior duodenal wall	Posterior gastro-enterostomy. Repair ventral hernia	Died four and one-half years later, following operation for marginal ulcer
19	M	42	Nov 26, 1913	Symptoms three years, intermittent severity	Thickened indurated duodenum adherent to gall-bladder	Posterior gastro-enterostomy	Died after four years—probably angina
20	M	55	Apr 1, 1912	Symptoms fifteen years obstruction. Several hemorrhages	Duodenal ulcer adherent to stomach and gall-bladder	Posterior gastro-enterostomy	Obstruction on sixth day. Explored. Kink straightened. Good recovery. Died after six years, nine months
21	M	37	Aug 24, 1917	Two years' obstruction. Pain	Scarring both in anterior and in posterior duodenal wall	Posterior gastro-enterostomy. Appendectomy	Died—eight years, four months. Suicide. Had complete relief
22	M	49	Sept 1, 1906	Six months, nausea and obstruction	Indurated area in duodenum—anterior and superior	Posterior gastro-enterostomy	Died after seven years of carcinoma of sigmoid. Good health up to this period
23	M	40	Sept 25, 1912	Fifteen years. Hematemesis, pain	Indurated duodenal ulcer adherent to liver	Posterior gastro-enterostomy	Reported dead. Time and cause unknown

TABLE V
Summary of Deaths Which Occurred within Six Months following Pyloroplasty

Case number	Sex	Age	Date of operation	Condition of patient	Condition found at operation	Operation	Result
24	M	61	Jan 4, 1923	Well nourished Ten year ulcer history, pain and hematemesis	Ulcer scar about two one-half cm below pylorus	Pyloroplasty Appendectomy	Died — twenty-four hours — following persistent vomiting thought related to myocardial failure
25	M	55	Mar 10, 1920	Well nourished Pain for six years	Pyloroduodenal ulcer adherent to gall-bladder	Pyloroplasty — Excision of duodenal ulcer	Died—nine days—streptococcus pleurisy
26	M	48	Feb 25, 1924	Good condition Symptoms for fifteen years	Ulcer scar on anterior pylorus—duodenum	Pyloroplasty — Excision of pyloroduodenal ulcer	Died—eight days—obstruction — with pneumothorax and lobular pneumonia
27	M	32	June 13, 1913	Very anæmic Repeated hæmorrhages, with four-year history	Thick adhesions between ulcer on anterior duodenum and gall-bladder	Pyloroplasty — Excision of duodenal ulcer	Died — five weeks — following drainage of empyema
28	F	35	Dec 8, 1916	Perforated ulcer after four-year history	Perforation—1 cm anterior duodenum Partial closure by omentum, free peritoneal fluid	Pyloroplasty — Excision perforated duodenal ulcer	Died—six weeks—cause not given
29	M	46	Sept 19, 1921	Ulcer pains intermittent for fifteen years	Old duodenal ulcer with adhesions Chronic appendix	Pyloroplasty Appendectomy	Died—5 months—following operations for release of intestinal adhesions
30	F	54	Mar 30, 1915	Nine-year history—pain—poorly nourished	Duodenal ulcer	Pyloroplasty Cholecystectomy	Died—within six months—"ne-phritis"
31	M	44	Sept 27, 1915	Undernourished Ten-year history	Adhesions between duodenal ulcer and gall-bladder Chronic appendix	Pyloroplasty Appendectomy	Mental derangement two months Retention Died three months, following posterior gastro-enterostomy Pylorus was patent

TABLE VI
Summary of Deaths Which Occurred After Six Months following *Pylorectomy*

Case number	Sex	Age	Date of operation	Condition of patient	Condition found at operation	Operation	Result
32	M	55	Sept 26, 1921	Symptoms — four years Good condition	Cicatrized duodenal ulcer Chronic cholecystitis without stones Chronic appendicitis	Pylorectomy with excision of cicatrix Cholecystectomy Appendectomy	Died—(cardiac death)—after four years Excellent health after operation
33	M	30	Feb 11, 1916	Emergency operation for perforation — after three years of symptoms	Acute perforation of du- odenal ulceration	Pylorectomy with excision of ulcer	Died—suicide—after eight years Greatly improved after opera- tion
34	M	44	Feb 2, 1917	Symptoms for seven years Pain	Cicatrizing duodenal ulcer Adhesions to chronically inflamed gall-bladder	Pylorectomy with excision duodenal ulcer Appendec- tomy	Died — “apoplexy” — after ten years Had been in “perfect health”
35	M	40	Apr 4, 1913	Intermittent pain and nau- sea for years	Cicatrizing pyloroduode- nal ulcer, anterior	Pylorectomy	Died—after twelve years—Op- erative result good Several months of ill health “Over- work” before death

These tables require little comment, as they speak for themselves. The mortality rate is increased by the fact that all deaths within six months after operation, from whatever cause, are included. If these were not included, the elimination of cases 27, 28, 29, 30 and 31 would allow us to quote a “hospital mortality” of only 3, or 2 per cent, following *pylorectomy*. It will be observed also that the most common cause of early death following *gastro-enterostomy* was some form of obstruction. These cases, however, go back as far as 1909, when the “vicious circle” and other forms of obstruction were relatively more common than now, when, owing to improvements in operative technique, such complications are of infrequent occurrence.

THE RELATION OF BIOCHEMISTRY TO CANCER

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IN THE study of the human body the terms anatomy and physiology for many years were supposed to refer only to those tissues and functions that could be observed with the eye or the eye aided by the microscope, and the most minute particles visible with the microscope were about $1/10$ micron or $1/250,000$ inch in diameter. When the study of matter was extended to include smaller particles, anatomy became physics, and physiology, chemistry. Yet the most minute fragments of matter of which we have any knowledge are physical, and chemical changes, processes in a general way known as biochemical, take place only in these minute subdivisions of matter.

The extraordinary revelations of modern physics, ushered in by an understanding of those waves which are known as light, which travel approximately 186,000 miles a second, have introduced us into a new realm of thought. The conception of matter today is that two particles or waves are concerned, the electron, representing an extraordinarily active negative phase of electricity and the proton, positive and more massive, and that all matter is formed by varying degrees of fusion of electrons and protons in the form of atoms, which again are combined as molecules. Since the molecules are smaller than a ray of visible light, they do not diffract the light, but possess the characteristics of the mass. Colloids which are aggregations of molecules, and therefore larger in size, reflect rays of light. Colloidal particles include those from $1/1000$ micron or $1/25,000,000$ inch in diameter to those of $1/10$ micron or $1/250,000$ inch in diameter (visible to the eye aided by the microscope). Colloids, like molecules and atoms, are detectable only by ultramicroscopic methods.

A newer electric component is now comprehended as our understanding has enlarged, known as the photon, equally important with the electron and the proton. Electrons and protons are essentially indestructible. The photon has no such indestructibility. It represents the forces that are given off, under certain conditions, by atoms, consisting of masses of energy, with the same rapidity of wave motion and other characteristics of the electron and the proton, but it is destructible in the sense that the energy contained is completely dispersed as another force may be exhausted, or as it may be combined with atoms.

The light which makes plants grow and which gives us warmth has the double characteristics of waves and particles, and is found to consist ultimately of photons. The photon, then, has to do undoubtedly with our whole understanding of ultraviolet rays, some of the vitamins, and many of the

newer conceptions which concern the chemical exchanges of the body. As far as life is concerned, the photon is as important as the two better understood and longer known particles which we speak of as the electron and the proton.

The subject of light and its influence on the human body, and the potentialities of various kinds of food substances which in one way or another are derived from light and act as light carriers, opens up an entirely new aspect of metabolism as related to health and disease. In all of the known combinations of electron, proton and photon in our conception of physics, the elements still maintain a place, although a precarious one.

Investigations of the elements by Moseley, the brilliant young scientist, who at the age of twenty-eight was killed in the Gallipoli campaign, have brought out some interesting facts from which certain deductions can be made that apply to medicine.

We know that there are ninety-two elements varying in atomic weight from hydrogen, which is the lightest, to uranium, which is the heaviest, and that between each two elements in the progression of atomic weight there is approximately the weight of an atom of the element hydrogen. It is possible, although not yet shown, that elements which are close in the scale of atomic weight can be changed, experimentally, at least, into the element above or below. Miethe and others have attempted to convert mercury (200) into gold (196) thus carrying out the dream of the alchemist.

It is scarcely necessary to call attention to the enormous value of such investigations as related to the industries. The molecule of coal contains fewer atoms of hydrogen than the molecule of petroleum oil. Bergius has been able to force additional atoms of hydrogen into certain types of coal and thus has produced petroleum oil. With the extraordinary accomplishments of physics and chemistry as related to the industries, the production of artificial rubber, artificial silk, and artificial foods, many profitable researches in human metabolism are being initiated, either in the discovery of the causative agents of disease or those factors which have to do with the development of resistance to disease.

As illustrating the newer conceptions of the elements no better example can be taken than chlorophyll, the green coloring matter of plants, which is one of the most important substances in the world. Chlorophyll is able to convert the heat and energy of the sun's rays into power for transforming water and carbon dioxide in the atmosphere and certain inorganic materials from the earth into carbonaceous compounds. For this purpose, the element magnesium is essential, just as in the subsequent conversion of this material into heat and energy in the human body, the element iron is necessary.

Life is maintained in the cells by combustion, an exchange of electrons which is carried out in the colloids of the cells. In the bodily economy, the element oxygen, which composes from 18.5 to 20 per cent of the blood, by volume, is associated with iron, of which there are one or more atoms in every molecule of hæmoglobin.

In animals below the vertebrates, such as the *Amphioxus*, which in the scale of life stands between the vertebrates and the invertebrates, there is only white circulating fluid, and in this fluid the element copper takes the place of iron

In the vertebrates copper has a powerful influence on respiration. This curious relation of copper to vital processes is seen in the treatment of pernicious anæmia by the administration of liver. The extract of liver tissue appears to have the same effect as liver itself, and experimentally, in conditions of anæmia, the ash has the same effect, the essential elemental constituent is copper.

The liver is the great detoxicating agent of the body, and to a large extent the source of the plasma of the blood. If a measured piece of the spleen or other organ is placed in the abdominal cavity of an animal, harm may not result, but if a similar piece of liver is thus placed, the animal dies, and its liver shows the greatest effect from the resultant toxæmia.

Krogh has shown that the walls of the vascular capillaries contain contractile cells, derived from the non-striated muscle, which are to a large extent self-controlled. Under the circulatory pressure of the systole of the heart, the capillaries permit oxygen and molecular substances, such as the crystalloids and amino acids, to pass by filtration, osmosis, diffusion, and other forces, through the stomas in the vessel wall to serve vital purposes, to maintain nutrition, and produce heat, and energy. The ash of this combustion passes into the venous capillaries to be carried to the emunctories, and the blood passes to the lungs for a fresh supply of oxygen. When, however, certain toxic poisons, for example, histamin, paralyze the contractile cells, causing the stomas in the capillary walls to open more widely, larger bodies, possibly colloids just above molecular size, and fluids of the blood plasma, pass from the capillaries into the tissues, resulting in the condition known as shock.

Carbohydrates (glucose, $C_6H_{12}O_6$) and fats (stearic acid, $C_{18}H_{36}O_2$) have no powers of building the body. The carbohydrates furnish heat, from which we recognize only the carbon dioxide as it is exhaled from the lungs, because by oxidation, hydrogen, which is a source of great value for heat and energy, is converted into water, which is used in the system. The fats are oxidized slowly because of the small amount of oxygen they contain, but they produce a much larger amount of heat and a greater quantity of water than the carbohydrates. The utilization of water produced from oxidation of fats and carbohydrates is shown in the hibernating animal, whose temperature during the winter drops to about 50° , approximately that of the cave in which the animal takes his winter sleep. In the great retardation of all bodily functions and complete cessation of the function of the kidney, the physical needs are supplied by the slow oxidation of the stored autumnal fat which gives not only the little energy necessary to carry on life, but also the essential water.

Roger, a French experimenter, found evidence which led him to believe

that metabolism of much of the fat is accomplished in the lungs, where oxygen is plentiful. The fat is carried from the intestinal tract through the thoracic duct to the left subclavian vein and finally deposited in the arterial capillaries of the lung, into which it finally disappears. He demonstrated that the blood from the right side of the heart contains a much larger amount of fat derivatives than the left. The experiment seems to show that oxygen is necessary for the conversion of fat, and that the conversion of fat into a form suitable for bodily use is not primarily a function of the liver.

Protein, on the contrary, contains in addition to the elements carbon, hydrogen, and oxygen, the element nitrogen and a little of the element sulphur. The nitrogen we know is necessary to the building of tissue, forming compounds in which may be deposited calcium and other elements. Seventy-nine per cent of the atmosphere is nitrogen.

The oxidation of carbon and hydrogen within the body which gives rise to heat and energy is the outstanding feature of all animal life, but while the normal cell functions within normal limits, the carcinomatous cell oxidizes without control and without function. The analogy between the rapid growth of the fertilized ovum and growth of cancer has often been pointed out. The growth of the one, however, is orderly and with purpose, of the other disorderly and without purpose.

There are two theories of biological oxidation, the oxygen activation theory of Warburg, and the activation-of-hydrogen theory of Wieland. Hopkins gives the weight of his authority to Wieland's theory as best explaining the chemistry of biologic processes.

Since uncontrolled combustion of food material is the most important feature of the growth of cancer, it is worth while to consider how combustion normally is controlled.

If a pound of glucose is burned outside the body it will produce the same amount of heat and energy as if burned in the body, but in the air it will burn only at temperatures over 400°C . What holds the temperature of the body at 98.5°F ? The best explanation at present is that oxidation is carried on by catalysts or enzyme action. Kendall and others have shown that one of the agents which influences oxidation, glutathione, contains one atom of the element sulphur to the molecule and that if this atom of sulphur is removed, it ceases to function in this way. Sulphur itself has no such effect on metabolic processes. When a growth begins to undergo hyaline degeneration, there is a definite slowing up of the malignant process. In this connection, it is known that hyaline and keratin contain a high percentage of sulphur. This indicates two different effects of sulphur depending on its form of combination.

In studying the manner of oxidation in the body, it is apparent that the size of the nucleus of the cell determines the rapidity of the process. Biochemically, the nucleus appears to be the agent of oxidation which enables the cell to secure nourishment. The most rapidly growing embryonic cells of the body are those derived from the chorionic villi (Langhans's

cells) Langhans's cells have extremely large nuclei and undergo the most rapid division of any normal cells in the body, but there is no peculiarity in the structure of the nucleolus and the cytoplasm of the cells. Wilson, MacCarty, and Broders have shown that the malignant cell has not only a large nucleus, but, also noteworthy, a large nucleolus. Broders's classification of the malignancy of tumors has been based on a comparison of the malignant cell with the normal cell of the same tissue. In brief, it has been found that when malignant cells are compared with the rapidly growing normal cells the nucleolus as well as the nucleus is found to be greatly enlarged. It would appear that the size of the nucleus controls the total activity of the cell in relation to its increased blood supply, whereas the nucleolus may control the function of the cell in relation to the necessities of life. The increase in the size of the nucleolus, as well as the nucleus, means not only rapid and uncontrolled production of cells but cells without function, which is characteristic of cancer. In other words, the greater the variation of the malignant cell over the normal cell the more malignant the growth.

The excess of nucleus in the malignant cell over and above the normal cell is evidently due to an excess of the normal activating enzyme or oxidizing agent which controls combustion. Heat and radio-active substances and some elements reduce or destroy the oxidizing power of the nucleus and the nucleolus particularly of malignant cells which are less resistant than normal cells.

Bell, of the University of Liverpool, in his work with the use of the element lead in cancer, has obtained some very interesting results, although the practical application of lead in the treatment of cancer has not proved very successful and not free from danger. His attention was called to the possible value of lead by observing its effect on workers in lead at Liverpool. Persons who had advanced cancer and yet were forced by the exigencies of life to earn, and who had taken up employment in the lead works, often experienced a decided change for the better. Pain disappeared, the growth became very greatly reduced, due to the effect of lead on oxidation of the rapidly growing cell and the malignant processes occasionally were held in abeyance for a considerable length of time. Bell is particularly interested in gynecology, and he learned that lead frequently caused sterility, usually temporary in both men and women who worked in the lead works. This fact led him to investigate not only the effect of lead in cancer, but also its destructive effect on the rapid growth of the syncytial cells of the chorionic villi (Langhans's cells). He was able to show marvelous resemblances between these controlled but most active embryonic chorionic cells and malignant disease.

The element gold in colloidal form has been shown to have, to some extent such an effect. Arsenic, another element, at various times has had a reputation as a cancer cure, both as an external application, an escharotic, and given internally. At times it has enjoyed a reputation as a palliative,

probably through its effect on the bodily tissues encouraging resistance of the normal tissue and acting deleteriously on the lowered vitality of the cancer cell. Those who go back a quarter of a century and remember the work of Alexander, of Massachusetts, in the treatment of cancer with arsenic, cannot get away from the conviction that it had some effect, but it did not cure. While it is quite true that neither lead nor arsenic has achieved a solid reputation as a curative agent, they at least direct our attention to susceptibility of the cancer cell to certain chemical agents.

Fischera of the University of Rome, in the study of certain types of tumors associated with pregnancy, noticed the regression of tumors due to the absorption of substances derived from embryonic tissue. Acting on the known facts, first that all living animal tissue, as the result of its energy, produces metabolic substances which are poisonous to living tissue of the same kind, and, second that the more immature the cells of the body, the more effective these poisons. Fischera manufactured serum from human embryos expelled between the second and sixth months, and injected this serum into patients suffering from cancer. The effect on the living embryonic tissues was most marked, and to some extent the experiments showed cell specificity. Extraordinary effects were sometimes produced. In certain cases the malignant growths were greatly reduced, and for a time the patients were partially relieved from some of the more serious symptoms, especially pain. In spite of this early improvement, however, the patients were not cured. Of late, Fischera has been experimenting to see whether, by inoculation, the tissues of the body could be rendered immune to cancer, just as the development of smallpox is prevented by vaccination. The proofs with regard to this experiment must depend on careful investigations, conducted over long periods, on an enormous number of persons, with proper control.

Carrell's observation is significant, that in the growth of malignant fibroblastic tissue of fowl cancer under glass, there was acid reaction at the progressing margin of growth, whereas in the slower growth of normal tissue it was alkaline.

Passing from the specific reactions connected with these chemical changes which might be multiplied by relevant observations, we come to an important question, that of the fluids of the body, especially as related to the acid-alkali content.

Recent researches by McDonald, at the University of Pennsylvania, appear to show that persons whose reactions are toward the acid side do not often have cancer, as compared with those persons whose reactions are toward the alkaline state. The detection of changes in the acid-alkali balance requires most delicate methods for its determination. The alkalinity of the body tissues, while exceedingly slight, is fixed, and never in life becomes acid. Cell growth is accelerated by a preponderance of the element sodium and inhibited by an excess of the element calcium, which brings up the question of the parathyroid hormone, in relation to calcium reserve in the blood and tissues.

The rather curious relation of the acid-alkali balance of the body to growth also is deserving of study. Seventy-five per cent of the human body is composed of water, and much of this water is in a bound state. Unbound water is only slightly compressible, but when it is adsorbed with silica, a certain proportion of it becomes bound, and thereby is reduced in volume to 75 per cent of the original volume. Gortner, the eminent agricultural chemist, of the University of Minnesota, in working out the question of bound water, found that plants which froze readily contained much unbound water which could be squeezed out in a press, and that, on the contrary, in those plants that would not freeze in continued cold weather, the water content was largely bound. This was also true of desert plants. These observations provide an easy test as to what plants would be suitable for regions of the country that had either prolonged winter or excessive dryness.

The essential alkalinity of the human body is very slight and extremely refined methods are required for differentiation. It is comparable to the difference between ordinary tap water and distilled water, and the distilled water must not be exposed to the air, or it will absorb acid from the atmospheric carbon dioxide. No gland in the human body produces an acid. We think at once of the hydrochloric acid of the gastric cells, but it has been demonstrated by Harvey and Bensley that this acid is formed not in the gland substance, but in the acini of the glands by the union of the necessary chemical elements. Acidity of the large intestine depends upon bacteria.

In the study of the cause and prevention of malignant disease biologic phenomena of a biochemic nature assume an importance which only recently has been recognized.

Cancer never develops in sound tissues. Chronic irritation, by opening up an atrium for possible entrance of microorganisms to the body from the outside, seems to suggest an external agent. This does not explain why in certain cases in which the sources of chronic irritation are very slight, cancer develops, while in others in which the sources of chronic irritation are very extensive for great lengths of time, cancer does not develop. It is difficult to surmount the fact that when cancer has extended by metastasis to a new situation, it produces the histopathologic picture of the tissues in which it originated, rather than that of the organ which became affected secondarily. If the disease were due to a foreign invader, it presumably would reproduce the type of cells of the newly invaded tissue rather than that of the primary seat of the tumor. In any event, the agents which act on the cell to produce malignancy become an integral part of the cell itself, as metastasis in the human species takes place only by transplantation of the cell.

One factor of supreme importance which has not been sufficiently stressed is that individuals vary in their susceptibility to the cause or causes of cancer, whatever they may be. In no other way can we explain why 90 per cent of persons do not have cancer and 10 per cent die from it. It is as logical to accept the hypothesis that 90 per cent of persons have greater resistance

to cancer than the 10 per cent, as to attempt to force an explanation that only 10 per cent come in contact with hypothetic causative agents

If the patient's susceptibility to the disease is the important factor in the development of cancer, the situation of the growth must be determined by the organ or tissue subjected to the insult of the precancerous lesion, and the grade of malignancy and the metastatic possibilities by the susceptibility of the body as a whole

The studies of Murray on tar painting, those of Gye and Barnard on the transplantation of the Rous fowl toxin, the work of Slye on cancer in mice, and of Bowing and Desjardins on the effect of radium and X-ray in lessening the malignant character of the growth, all point to local and general susceptibility as being perhaps the controlling factor in the genesis of malignant conditions, and indicate that the possibilities of increasing resistance to cancer in the more susceptible individuals is not only a possibility but a goal which every effort must be made to reach

HOMOTRANSPLANTATION AND THE SEVERAL BLOOD GROUPS

CONSIDERATIONS ON EPIDERMAL GRAFTS MADE BY THE THIERSCH METHOD

BY WLADYSLAW DOBRZANIECKI, M D

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FROM THE SURGICAL CLINIC OF THE JOHN CASIMIR UNIVERSITY PROFESSOR HILARY SCHRAMM DIRECTOR

THE free transplantation of human tissues constitutes one of the most recent triumphs of surgery. The process dates scarcely as far back as the second half of the nineteenth century. Ollier (1858), Reverdin (1869) and Thiersch (1886) were the earliest pioneers in free grafting of the skin, practiced by them clinically. Although certain ideas formulated by them and others have at present merely historical interest, it is nevertheless true that free transplantation of the skin, in which they took the initiative and which was developed later in another direction and with critical elaboration by Marchand, Braun, Lexer and Schone, constitutes a splendid page in the evolution of modern surgery. In emphasizing the importance of tissue grafting mention may be made of grafts of the important endocrine glands, of the cornea for replacing areas whose transparency has been impaired by burns, ulcers or grave trachoma, of the appendix after appendical ablation, of the divided urethra, fat grafts used for filling losses in the meninges and spinal cord, plastic operations of the articulations and those designed for esthetic purposes, the transplantation of vessels, tendons, cartilage, bones, nerves and periosteum, and even the experimental grafting of entire extremities or parts of them. Some of these procedures, it is true, are extremely difficult technically and require much experience, while they often fail of complete success functionally, or even anatomically. However, they represent material progress forward toward realization of the surgical idea—which is at first view so simple—of replacing organic defects by tissue identical with that which is absent.

By the term "free graft," we mean a rupture of the anatomical connections of a given tissue and its base and its transplantation to another site on the same individual or another individual of the same or different species. Thus, the term autoplasty signifies the grafting of tissues in the same individual, homoplasty, homeoplasty and isoplasty mean tissue transplantation from one individual to another of the same species, and heteroplasty means the same sort of operation as applied between individuals of different species. With respect to the grafting of inorganic and foreign materials, the procedure has had the term alloplasty applied to it by Marchand.

In the present paper we propose to describe certain details concerning epidermal grafts made by the Thiersch method, and also experiments showing the important relations of the several blood groups to homoplasty. The theoretical and practical foundations of epidermal grafts are principally due

to Reverdin, who attempted grafting upon healthy granulating tissues. His method consisted of covering areas devoid of skin with small bits of skin from two to six square millimetres in surface. Thiersch modified the method, elaborating a wholly different technique for this variety of transplantation. After a short time, the Thiersch method proved more satisfactory and largely displaced the Reverdin technique.

At present epidermal grafting is done by the Thiersch procedure, not only for replacing skin destroyed by lesions, burns, electric currents, freezing, trophic disturbances, and the like, but also for repairing conjunctival ulcerations (Everbusch) defects in the mucosæ of the nose, mouth (Thiersch Esser, Moszkowicz) and larynx, after operations of the middle ear (Politzer) and for plastic treatment of the parotid duct (Perthes). Esser employed Thiersch grafts in two cases for fashioning a subcutaneous œsophagus. The same operator restored the anterior portion of the bladder in malformations (ectopia of the bladder) by lining the internal surface of the abdomen by the Thiersch method and then connecting it with the existing structure of the bladder by means of plastic treatment. In operations upon the urethra, after its excision or in cases of hypospadias, it is necessary to correct local defects by applying the Thiersch procedure. Muller repaired a urethral length of eight centimetres in this way. Similar attempts have been made to cover with skin losses in the tissue of the dura mater, of the mucosa of the bladder and oral cavities, and in plastic treatment in congenital absence of the vagina (Albrecht). However, the last mentioned grafts have given no satisfactory or permanent results.

The original method devised by Thiersch has undergone various modifications with respect to obtaining the necessary skin, the thickness and dimensions of the latter and the preparation of the tissue to receive the graft. Lusk employed vesicating agents in order to obtain cutaneous vesicles, employing for covering purposes the epithelium thus separated from the underlying base. Mangold has offered, as a new method, that of sowing, or scattering, over the defective area fragments of skin contained in an epithelial suspension or broth (*Epithelbreiaussaat*). In its final period, this method is in no way different from that of Thiersch clinically or histologically, and is applied in the same conditions, practically. Among the more curious of the rather unfortunate effects accompanying this method we may mention the case presented by Hacker, in the treatment of the nasolacrimal duct. After introducing the epithelial suspension into the duct on a silk thread, the latter was worked through the duct several times and then left there for four weeks. Withdrawal of the thread formed a new canal.

Pels-Leusden and Reschke injected the epithelial broth or suspension into granulations which had not been cleansed superficially. After some two or three days, the granulating surface became clean, while islands of epithelium were formed here and there. In a case of trophic ulcer, Hilarowicz formed small pockets along the lips of the lesion, beneath the epidermis, and filled

them with the suspension. This method gave good results even in cases where peri-arterial sympathectomy failed of complete success.

Westhues cut Thiersch grafts into small bits and threaded them into a needle, drawing them into the granulating surface pierced in this way. A part of each bit was thus left above, and another part below, the granulating area. The grafts became fixed and adapted after two or three days. The granulations were then removed and regeneration of the epidermis occurred very rapidly.

Gohrbandt advises the use of grafts which are intermediate between those of Thiersch and those of Braun. Schlapfer considers the Thiersch technic suitable only for truly aseptic wounds. In the presence of suppuration or of presumed latent infection, Schlapfer prefers grafts of the Reverdin-Halsted type (for use in cavities affected with chronic osteomyelitis, X-ray burns, and the like). Braun introduces small Thiersch grafts four or five millimetres square into the interior of the granulation if the patient is restless or if the granulation is impure. Advancing from below, the epithelium makes its way through the granulation and spreads out upon the granulating surface, whatever the situation of the epithelium in relation to the surface. Braun claims success in 90 per cent of the cases, even if the granulating surface be very dirty. Mannheim similarly recommends for these cases the technic of Braun, rather than that of Thiersch.

As a general rule, epidermis for grafting is obtained from the external surface of the thigh or shoulder. Thiersch states that granulating surfaces may also be covered with epithelium taken from the lips or edges of the wound, whose central portion is thus covered. The denuded portion of the edge becomes repaired in a natural way in two or three days. Thiersch grafts may be obtained similarly from mucous membranes. Krusius grafted single hairs for forming eyelashes.

In cases where the tissue receiving the graft is not sufficiently freshened or bears no granulations, most operators advise curettage of the granulating surface. Others graft directly upon the granulations. Reschke believes that the epithelium has a certain purifying effect upon granulations, changing the appearance of the dirtiest wound so that it is altered and completely unrecognizable in two or three days. Braun shares this opinion and advises that epidermal grafts be applied at intervals of two or three weeks in burns or very febrile cases presenting wounds which are freely suppurating or soiled with urine or fæces. For rendering granulations aseptic, Williams and Clarens employ compresses moistened with Dakin solution, which are removed the evening before applying the graft.

Reschke calls attention to the point that attachment of the graft is promoted by previous application of the Röntgen rays. The same operator injects epithelium beneath the affected part in cases of rodent ulcer and tuberculous lesions of the skin, in order to arrest local nutrition and produce regression of the morbid process present.

It is worthy of remark that grafted epithelium may give rise to cysts

Reverdin observed this phenomenon (traumatic epidermal cysts) Klett has recently noted it in applying the Braun technic The question may therefore be raised as to whether malignant degeneration of the cysts may not occur Pels-Leusden states that the cells of grafted epithelium are too highly differentiated and too mature structurally to present any marked tendency toward cancerous degeneration

In grafting skin derived from other animal species (heteroplasty), that of dogs, chickens or the internal pellicle of an egg may be used, and with perfect success, as claimed by some writers However, our experience, always supported by histological study, causes us to believe that these so-called successes are really merely illusions The observations in question are not made with sufficient attention or with a sufficiently critical disposition Heteroplasty has been, in fact, wholly abandoned at the present time, exactly according to the same principle governing blood transfusion, which is also a method of grafting in the larger sense of the word

Until recently, surgeons have considered homoplasty, or grafting between two individuals of the same species, as something to be taken for granted and having no need of theoretical explanation The only condition required in such cases was that of close relation or consanguinity For testing the question, negro skin has been grafted upon an individual of the white race and conversely Good results have been obtained (Davis and Guthrie, and according to Lexer), so that certain writers consider homoplasty as equivalent to autoplasty

The favorable results obtained with homoplasty have led to experiments designed to determine conditions which are essential for successful grafting It has been proved in this way that, with homoplastic grafts of the skin, the human organism behaves toward the graft, after initial appearances of healing and after two, or at most after three, weeks, as it does toward a foreign body It either eliminates the graft with pus formation or it renders the graft gangrenous Degeneration, evident microscopically, and a sign of failure of the graft, appears much sooner Only embryonic epithelium acts more advantageously in this respect Experimental studies made with animals have shown that homoplastic grafting of the skin may be accomplished under certain definite conditions Carnot and Deflander have thus succeeded with guinea-pigs and Schone with young rats and mice of the same sex It should be noted, in this connection, that the lower the organism in the phylogenetic scale, the better the results obtained with homoplasty

The favorable results reported by most writers practicing human homoplasty, and the less certain results indicated by others who have paid special attention to the healing of the grafts, have called attention to the necessity for seeking causes of failure in homoplasty, especially in biochemical differences between the albumins and serums present in different individuals Such differences may, on the one hand, give rise to a toxic action of the grafted site upon the graft and create a form of immunity toward the grafted tissue or to a foreign albumin, or to one of different value It has, therefore,

been considered well to utilize, in grafting methods, recent biological advances accomplished in the field of homoplastic blood transfusion, as well as the fact that different blood groups occur in man. The first steps in this direction have been made by American authorities.

The phenomenon of agglutination, as well as the grouping of human individuals according to their types of blood, a grouping which is at present so important clinically, has suggested the idea that grafting upon a given organism certain elements derived from another individual of the same species might be possible without producing any injury in the receiving organism, a condition marking the success now accompanying homoplastic transfusion of the blood. Modern clinical methods attempt to utilize the fact of a certain biological relationship, making use of the blood groups present in different individuals. Clinical observations especially indicate that certain diseases, such as tuberculosis or cancer, appear more frequently in connection with certain blood groupings (Swider Kohn).

With reference to the homoplastic implantation of Thiersch grafts as associated with utilization of the several blood groups, the literature presents results which are good, and even very favorable. An entire series of operators are now basing success in homoplastic Thiersch grafting upon conformity with, or at least homonymy with, the several existing blood groups. Grafting may be thus rendered surely successful, according to Schowan, Jelanski, Deucher and Ochsner, Kubányi and Dyke, as well as recent writers interested in the subject in conformity with modern problems raised by homoplastic methods and in connection with the blood groups. Deucher and Ochsner have thus noted positive results in two cases involving the same blood groups. According to these writers, the conditions essential for successful grafting are homonymy of the blood groups and youth and consanguinity of the donor. Jelanski has performed seventy-eight transplantations, of which eleven were autoplastic and sixty-seven monoplastic. Histological examination seems to show that, with identical blood groups, the microscopical image is similar to that occurring with autotransplantation. The only difference is that the growth of the epithelium occurs atypically, that cellular infiltration and degenerated forms of epithelial cells appear, and that the graft becomes finally resorbed and serves as a substratum for regeneration of the epidermis. If the blood groups are not homonymous, the transplanted skin is immediately eliminated without the slightest perceptible tendency to regeneration.

In the four cases reported by Kubányi, homotransplantation proceeded in a similar way, the graft not becoming fixed throughout its entire surface, but only as islands of tissue. Necrosed portions were eliminated. Beginning growth of epidermis was, however, visible below and it was finally possible to cover fairly large spaces with Thiersch grafts taken from donors whose blood corresponded to that of the receivers in iso-agglutination. It is a remarkable fact that only the older writers speak of favorable results obtained with homotransplantation and even with heterotransplantation. Key, Davis and Guthrie have observed perfectly satisfactory grafts made from

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negroes to white individuals, and vice versa. Skin taken from fresh cadavers has also been grafted (Bairns), but homotransplantation has usually been performed between members of the same race or family.

Ideas reviewed above have been modified radically as time has progressed. Heterotransplantation has thus completely lost its position in modern scientific literature. Homotransplantation is, as we have remarked, now inseparable from the question of iso-agglutination. While some competent operators believe that homonymy of the blood groups constitutes a condition rendering grafting surely successful, others think that iso-agglutination in no way affects the final result of homotransplantation, which is not favorable. After numerous studies and research, Lexer and his school conclude that, in spite of blood homonymy, every transplant perishes in about fourteen days from dry gangrene, from elimination due to infiltration or suppuration, or from the appearance of a scar. As to the successes which have been reported, Lexer claims that they are not really true or that they have been insufficiently observed.

Eden obtained no result in four cases of homotransplantation of the epidermis, the blood groups being homonymous. In two cases, the grafts appeared to have become well fixed after three weeks, but by the end of the fourth week they separated, on account of the granulation proceeding below them, and finally died. Oshima has also confirmed the point that, while one may speak clinically of seemingly perfect implantation of homoplastic grafts occurring in some sixteen days, such grafts present histological signs of degeneration.

In a case in which the writer did homotransplantation by the Thiersch method in a man, thirty-one years of age, on account of an extensive chemical burn of the third, or even fourth, degree, it was noted that the graft persisted alive, in agreement with the principles of iso-agglutination. The burn affected the entire face. The tissue destroyed included a part of the right cornea, the entire dorsal portion of both hands, including the articulations, the feet and a part of the palms of the hands. The general condition was grave. Blood transfusion was performed, the blood of donor and receiver being of group IV (by the Moss grouping). The transfused blood was taken from a female cousin of the patient, on the maternal side. The patient was affected with a catarrhal state following oedema and irritation of the laryngeal mucosa. This catarrh continued for nearly three weeks. The patient was treated by a dermatologist for a month. During this entire period, the surface of the wound was completely covered with dirty pus and necrotic detritus whose elimination was slow. The extensor tendons of the hands were partially necrotic and fissures were present in some of the digital articulations. The temperature remained constantly at 38.8° C, the grave general condition continuing steadily. Although the wounds were covered with purulent secretion, the denuded regions were covered with Thiersch grafts, without awaiting the occurrence of healthy granulation.

In all cases where the epidermis is lacking over large surfaces, we believe that it is necessary to cover denuded areas as soon as possible, on account of the grave general alterations produced by extensive cutaneous denudation. This attempt should be made by means of any of the various methods suitable in such cases, as we remarked at the outset. It is better to risk only partial

success in grafting than to neglect a grave lesion of this kind, and leave it to its fate. If the wounded surface be covered with abundant secretion, we proceed in the following manner:

For a period of about twenty-four to forty-eight hours we apply compresses moistened with normal saline solution before applying any plastic operation. This we do according to the appearance of the wound and its degree of granulation. The compresses are renewed every two hours. This



FIG 1.—The metallic network for the Thiersch grafts

treatment allows cleansing of the wound. The fibrin which covers the granulating surface sometimes like a membrane is eliminated. The wound does not bleed and cannot give rise to hematomas capable of lifting Thiersch grafts and impairing their vitality. In order to avoid this condition, we never excise or curette the granulations. At denuded sites not yet properly cleansed, the possibility of satisfactorily implanting Thiersch grafts is doubtful. In such cases, we therefore employ capillary drainage of the affected surface, as follows: Before placing the Thiersch grafts, we lay upon the wound parallel threads of catgut, lying two to three centimetres apart. If necessary, we form a sort of meshwork

tending to direct the secretion to the lowest point, due regard being given to the position of the patient. The capillary drains are placed in proper position every day. They are gradually shortened and may be removed in five or six days, at the moment when it is possible for the graft to become firmly united with the underlying surface. This procedure has proved to be perfectly effective in cases of suppuration of the granulating surface. We used it several times in the case mentioned above, as well as in other cases, as, for example, in a plastic operation required for repair of losses following a large carbuncle, in cancer of the breast with secondary complication, in separation of the edges of a wound through suppuration, in lesions of the alæ nasi

originating in the nasal cavity, and in similar conditions. We employ this procedure whenever circumstances permit. We naturally refrain from using it in cases where it is probable that the graft can be implanted directly, and without preparation. As for the treatment applicable after covering the denuded area by the Thiersch method, we favor treatment allowing free access of air. Such open-air treatment gives very good results. The region which has been covered with Thiersch grafts is, in turn, covered with a metallic network of large meshes, maintained firmly in place with plaster, which thus quite prevents any slipping out of position (Fig. 1). We cover the metal meshwork with a strip of sterile gauze, or with a compress. The meshes permit exact inspection to note whether the grafts remain alive, to permit removal of secretion accumulating at the edges of the wound, to shorten the capillary catgut drains, and the like. Should a serous liquid be secreted beneath the epidermis, as shown by the formation of vesicles, the latter are pierced with a large needle. The reticular bandage mentioned has the advantage over other bandages that it allows no marked quantity of secretion to accumulate upon the skin, that it obviates maceration of the grafts, and that, when the bandage is changed, no risk is incurred of loosening already adherent epidermis. Wydler employs thin slices of cork, and Halsted employs silver leaf, for covering the transplanted epidermis.

In cases where it is impossible to be absolutely sure that an epidermal graft will remain immobile until success finally occurs, as, for example, in a nasal cavity, we suture the borders of the graft to the surrounding skin, using sterile sutures of silkworm gut, or horsehair. The latter are preferable to sutures of silk or catgut in that they do not absorb the secretion.

With respect to anæsthesia of the lateral surface of the thigh (the local nerve being the *n. cutaneus femoris lateralis*) for removal of the epidermis, the method devised by Nystrom is insufficient. For this reason, we make injections about the selected site. A point of great practical importance is the fact that neither the tincture of iodine nor the more recently employed antiseptics, such as yatien or rivanol, have any harmful effect upon the vitality of the transplant. (Kamey.)

Here we should remark that in cases where good esthetic results are especially desirable the entire surface should be covered with a single Thiersch graft, as far as possible, for the application of a number of small pieces gives rise to the formation of a honeycomb structure, or raised borders, occurring at the edges of the different pieces in question. The Thiersch grafts must be stretched out upon the bed prepared for them, otherwise folds occur which persist in spite of massage. If the wound is a soiled one, grafting should be attempted only when the edges of the wound have begun to adhere locally and when proliferation of the epidermis has already begun.

In practice, it is necessary to bear in mind certain conditions which appear only some two weeks after the transplantation. Perfect implantation of the graft by no means completes the process occurring in the substratum

The changes referred to appear clearly when the open surface is large, proliferation occurring, with formation of a scar. In our case, the scar of this kind displaced by a third of the edge of the hair upon the patient's forehead. Having had a high forehead before existence of the lesion and its treatment, the patient perceived, after a few months, that his forehead had become lower.

Bits of epidermis grafted by the Thiersch method become of a pale pink color immediately after adhesion is complete, and preserve this coloration. In our patient, no grimaces or marked facial movements were possible for a period of five months. Sensation in the grafted parts began to reappear toward the end of the third month. After the sixth week, parts covered with the Thiersch grafts were paler than the surrounding skin, were very



FIG. 2.—The entire face covered with the Thiersch grafts

mobile in relation to their sites, could be folded, were dry and shining, did not resemble normal skin, could bear either high or low temperatures, had no tendency to produce fissures or to ulcerate, and were not different from normal skin so far as sensibility was concerned. The honey-combing formed between sections of the skin had wholly disappeared (Fig. 2).

In the same case we employed the Thiersch technic, applying autoplasty with one hand and homoplasty with the other, as it was impossible to graft skin on the denuded cutaneous areas because of supuration and on account of the gravity of the general condition. We did both operations at the same sitting, in order to be able

to follow up directly and in a parallel way, the implantation of the identical and the foreign grafts. In the regions grafted conditions were identical and the dimensions of the denuded areas were the same (fifteen by thirty centimetres). For the homotransplantation we used epidermis taken from an individual of the same age as the patient and of the same blood group (group IV, as classified by Moss). The patient was a Hebrew. Eight days after operation the homotransplant appeared well fixed, as also did the autotransplant. As compared with the graft taken from the patient, the homotransplant bore a much greater resemblance to the normal skin, the autotransplant being of a livid hue. It was curious to observe that, after the sixth day, skin was shed through the entire extent of the homotransplant, the epidermis loosening in large flakes, while the epidermis derived from the patient was shed only in small scales. After six weeks, the homotransplant remained solidly attached to its bed, as proved by the fact that it could not be lifted from its site and formed wrinkles when the arm was extended. During the seventh week, the epidermis began to take on a livid color, the

bed of the graft had acquired a spongy consistency and, exactly forty-one days counting from the day of grafting on, in other words, in six weeks, the grafted segment began violently to yield to necrosis, which rapidly extended from the circumference toward the centre. Five days later the entire denuded area was without epidermis and covered with an unhealthy and impure granulating surface. Here it was necessary to perform, later, an autotransplantation, after previous cleansing of the wound.

This case merits attention because the homoplastic graft seemed to be becoming progressively implanted during a period of six weeks. According to Lexer, all grafts perish in three weeks and histological examination reveals signs of degeneration by the eleventh day, the epidermis becoming detached from its bed, the nuclei taking no stain and a young granulating tissue appearing, and Lexer states that these conditions occur regardless of all circumstances duly provided to assure success, such as conformity to blood groups, consanguinity, identity of race, and similar factors. From material which he has collected Lexer draws the conclusion that those who report successful homotransplantation are mistaken or have not made adequate observation. If the denuded area is small, epidermis supplied by the patient proliferates from the edges of the denuded area to points lying below the graft and covers the wound by imitating the conduct of foreign epidermis. Schiøtt, my chief, practiced homoplastic grafting of the epidermis thirty years ago, in several hundreds of cases. Because of the ideas then prevalent, he duly considered the factors of age, sex and consanguinity. Never in a single instance did he obtain the result desired, because the grafts always became necrotic before the end of the first week.

The question of homotransplantation has been considered, during recent years, upon a larger basis, especially in connection with blood transfusion and iso-agglutination. At all events, it is legitimate to affirm that the vitality of the graft may be prolonged in its new medium by creating conditions similar to those existing in its original environment, as shown by our concrete case. Among other necessary conditions, homonymy of the blood groups must also be utilized. The possibility of homotransplantation has thus far been demonstrated only in twins originating in the same ovum. According to Bauer, these twins represented individuals who were constitutionally identical and who were a form of reciprocal copy in all respects, concerning height and size, blood grouping (both belonging to group II, of the Moss scheme), dimensions of all corresponding peripheries, finger prints and other characters. In Bauer's case, in which the twins presented syndactyly, a bit of skin measuring five by 12 centimetres was taken from one twin for grafting upon the other. In order to check the result, autotransplantation was done upon one of the twins. The favorable results obtained were identical. In view of this exceptional case, Bauer expresses the opinion that the grafting of entire organs should be practicable under the conditions present in his case.

Opinions differ concerning the causes producing failure of homotrans-

plantation Oshima thinks that biochemical differences in the blood serum of the receiver act upon the graft in a way thus far unknown, producing degeneration, while a group of other factors leads to the occurrence of non-bacterial inflammation in the tissues about the graft, the result being necrosis and elimination of the graft Schone thinks that necrosis of the graft is due to a toxic action in the tissue juices, accompanying local or general immunity to foreign tissue, or that the graft succumbs from inanition, owing to a lack of material necessary to life or to incapacity of assimilating necessary nutritive substances The fact characteristic in these cases is, that in the higher animals and even in those existing under parabiotic conditions, homotransplantation has not given better results when performed by free or pediculated plastic treatment

The causes of failure in attempts at homotransplantation should doubtless be sought elsewhere than in the blood, for clinical and experimental efforts at the implantation of grafts present biological proof which is more sure and more delicate than that derived from serologic analyses dealing with precipitins, iso-hemolysins and iso-agglutinins According to Ribbert and Ehrlich, the reason for favorable results obtained with homotransplantation is referable to biologic differences in the leucocytes of the individuals concerned Eden remarks that the absence of positive results is due to alterations produced traumatically in the local agglutinative conditions of the substratum

We are at least obliged to prolong as much as possible the life of the homotransplant Here the blood serum has a very important influence The studies made by Kubanyi and Jacob show that, even with explantation, various tissues remain alive for a longer time when placed in blood serum of the same group, surviving for seven to eight days, and perish sooner if placed in serum of a different group, in which they live only two to three days In cases of homotransplantation, Baetzner and Beck inject, in increasing doses, the serum of the donor and the extract of a given organ, with the idea that in this way they may turn aside antibodies formed against the graft, the antibodies thus uniting rather with the serum and extract injected than with the cells of the homotransplant Such are some of the ways employed by students in seeking methods for prolonging the life of the graft Lexer was able to maintain graft-survival for eight weeks by adding the serum of the donor

Others have succeeded in retarding the death of transplanted epidermis by employing metallic saturation Lehman and Tamman made use of electrocollargol, while Tamman and Patrikalakis employed colloidal copper

Experience has proved that if the superior cervical sympathetic ganglion, as well as a portion of the sympathetic trunk be removed, necrosis of the graft and healing of the wound occur more rapidly with homoplasty, but that autotransplants adhere much more exactly and with fewer difficulties Tinozzi explains this fact by increased blood flow directed to the necessary point

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Williams has reported the completest case published concerning the preservation of an autotransplanted graft. He describes the aspect of a graft thirty years old, differing from the surrounding tissues in that it was much less sensitive and much dryer than the surrounding parts. It was, however, perfectly satisfactory from the esthetic viewpoint.

Summarizing, we may say that, although we do not yet know how to create conditions necessary for assuring the fixation of a homotransplant, we can nevertheless prolong its life by selecting suitable blood groups, by injecting the blood serum of the donor and by applying metallic saturation to the graft while it is still alive.

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THE FUNCTION OF THE GALL-BLADDER *

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NEW YORK, N Y

THIS WORK WAS AIDED BY A GIFT OF MRS JOHN L GIVEN IN SUPPORT OF SURGICAL RESEARCH

SOME years ago I collected the information which was then available concerning the gall-bladder,¹ and was forced by the assemblage of facts to the conclusion that the gall-bladder is an organ of absorption. I expressed my conclusion to the effect that the cystic duct is, under normal circumstances, a one-way tube, "under normal conditions, whatever passes into the gall-bladder through the cystic duct, never passes out again through the cystic duct." By this I did not mean that if, at laparotomy, the surgeon grasps the gall-bladder, and squeezes it with sufficient force, bile could not be forced out of the cystic duct. If the surgeon, under the same circumstances, should apply the same technic to the stomach, he (or his anesthetist) might conclude, with the same justification, that the stomach empties through the œsophagus.

The facts which led me to this conclusion were derived from the study of the embryologic history of the organ, the development of a remarkably duplicated and folded mucosa, the peculiar and striking blood supply, and the elaborate and relatively large lymphatic system, the parietal sacculi, and their apparent reaction to cholecystectomy, the relation of the muscular coat to the mucosa, the anatomical position, the broad attachment of the gall-bladder to the under surface of the liver, and the two valvular structures at the outlet—the S-shaped curve of the cystic duct, and the curious valves of Heister.

About the same time as my own publication, papers were published by Halpert,² and by Demel and Brummelkamp,³ in which similar conclusions were reached. Halpert⁴ is apparently, like myself, not yet convinced that the point of view is wrong.

Since that time a great number of publications have appeared, designed to prove that the gall-bladder does empty through the cystic duct. I fail to find in any of them a suggestion of an explanation of why such a contrivance is necessary for digestion. If the liver must provide a supply of concentrated bile for the beginning of digestion, why should not the salivary glands, the stomach, the pancreas, have similar provision? Why do the processes of beginning digestion need a more concentrated or a different bile than the later stages of digestion?

Let us examine the methods which have been used in these studies which may be grouped under four general headings. The method of direct observation under varying physiologic conditions has been tried in every conceivable form. The difficulties of this method are perhaps best illustrated by the fact that the most simple suggestion, ligation of the cystic duct, is impossible without interference with the delicate lymphatics which run along the cystic duct, or even a more serious involvement of the blood supply of the gall-bladder.

* Read before the New York Surgical Society, May 8, 1920

Any method of direct physiologic observation is open, therefore, to the basic criticism that abnormal factors are introduced. Another form of direct observation is to kill the animal and examine the gall-bladder under varying conditions of digestion and so forth. It is perfectly obvious that this method tells accurately only what one sees, if the gall-bladder is found empty and collapsed, that is all it will reveal. It is to be noted in experiments of this type, reported by Mann and Higgins,⁵ that the gall-bladder was not found empty except in those animals which showed, by the injection of the lacteals, that absorption, in general, was in progress.

The second method, which has been very extensively used, is to introduce directly into the gall-bladder, at laparotomy, the iodized oil known as lipiodol. This is an excellent medium, from the standpoint of the radiologist, since the iodine content is so high that a very sharp contrast shadow is produced. But it does not seem to have occurred to those working with it that it is an extremely poor medium for physiologic studies. Lipiodol is not absorbable by any of the membranes of the body. When introduced into a body cavity, such as the joint capsule or the pericardium, it remains, apparently, until it can be removed by a slow process of emulsification and phagocytosis. The illustrations in a recent paper by Whitaker⁶ would indicate that lipiodol is taken up by the mucosal cells of the gall-bladder. The fact that lipiodol would remain for so long a time in the gall-bladder, as shown by the experiments of Graham and his co-workers,⁷ raises the question of whether one should interpret these illustrations in Whitaker's paper as a real absorption, or as an attempted absorption which results in a complete plugging up of this channel.

Therefore, I contend that the use of such a medium in the study of an organ whose function may be absorption, is just as unsuitable, just as incapable of leading to correct conclusions as would be the filling of the upper intestine with bird shot, as a method of inquiring into the function of the upper intestine. Such a filling of the intestine with small particles of lead would undoubtedly give a beautiful contrast shadow, and would undoubtedly lead to the conclusion that the intestine is not an organ of absorption.

The third method of study has been with the use of the dye devised by Graham for cholecystography. This method has many advantages, since the dye can be introduced into the gall-bladder through normal channels, that is without disturbance of the conditions normal to gall-bladder function. Yet there are certain peculiarities of this method which have not been evaluated in the interpretation of results. It is a perfectly obvious clinical fact, as seen from the oral administration, that this dye can be taken up from the intestine into the circulation, from which it is, more or less, specifically removed by the liver and excreted into the bile stream. It is equally obvious, from the clinical facts, that after intravenous administration the dye follows this same route. The specific value of the substance depends upon the following of this route. Gaining entrance to the gall-bladder, the iodine present in the dye in the gall-bladder casts a shadow on the X-ray plate. Now, if absorption is going on from the gall-bladder—and no one doubts that absorption of water

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is taking place, since probably the oldest known fact concerning the gall-bladder is that the bile in the gall-bladder is more concentrated than the liver bile^{8, 9}—a water soluble material, such as is Graham's dye, would pass out in solution in this water. This absorbed dye, reaching the circulation would naturally follow the same path.

I believe this is the explanation of the experiment which led Copher¹⁰ to the conclusion that the gall-bladder must empty through the cystic duct. He found that the shadow persisted after the ligation of the common duct because, he concluded, it could not escape, under these circumstances, from the cystic duct. I believe this experiment can be explained as a constant circulation of the dye, from gall-bladder to blood stream, to liver and back to gall-bladder, as well as by the inability of the dye to pass out of the ligated common duct.

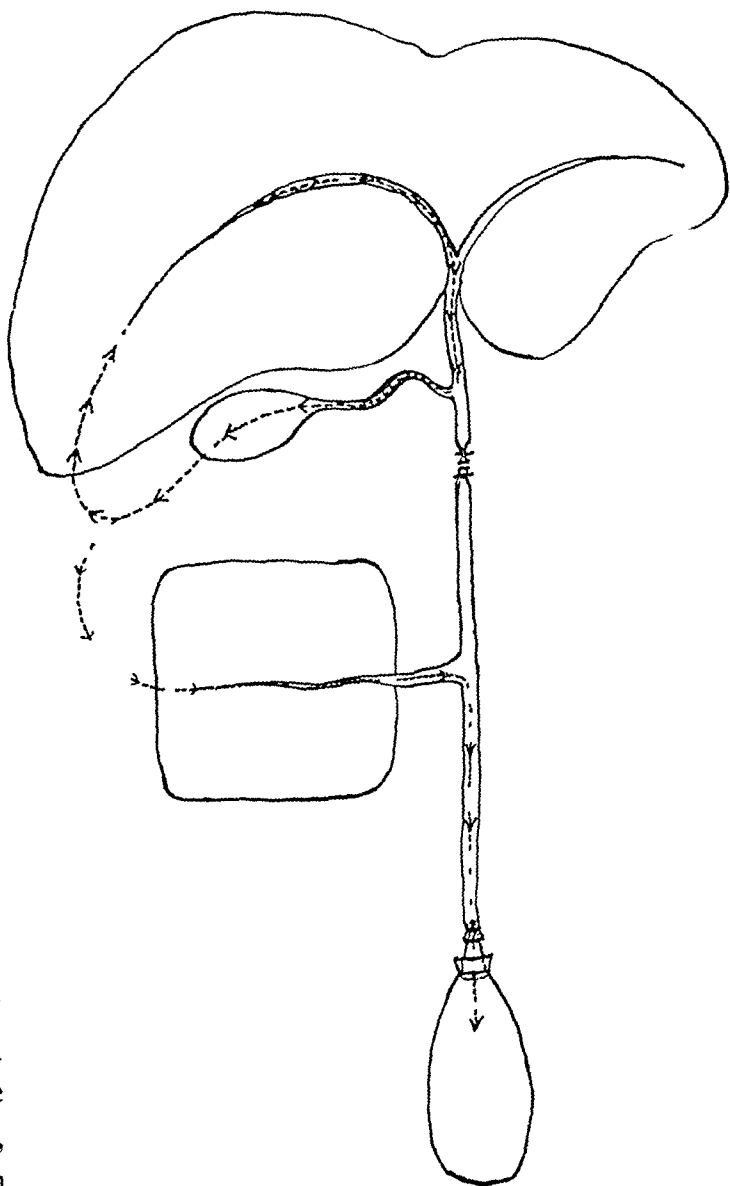


FIG. 1.—Schematic diagram See text

Let us repeat this experiment by introducing into the gall-bladder a substance which, if absorbed, would pass out of the body through other channels than the liver, simply filling the gall-bladder, at laparotomy, with 10 per cent sodium iodide, and, at the same time, ligating the common duct. A dense shadow of the gall-bladder appears, and in one experiment had disappeared at the end of one hour.

Or, let us slightly modify Copher's own experiment. The gall-bladder is filled with a suitable solution of Graham's dye at laparotomy. The common duct is tied below the cystic duct, but above a duct which, in the dog, enters the common duct from the lowest lobe of the liver. Then into the lower end of the common duct is introduced a cannula to which a rubber bag is attached. If the gall-bladder shadow is disappearing by absorption, under the conditions of this experiment, a certain amount of dye will be shunted out of the circula-

tion into the lobe connected with the rubber bag, and after a time the iodine should have more or less disappeared from the gall-bladder, and be present in the rubber bag

The details of this experiment are shown in the schematic diagram (Fig 1), and the results as determined by quantitative analysis of the content of gall-bladder and rubber bag in two experiments are given in Table I

TABLE I

	Amount of Iodine Injected into Gall- bladder (Milligrams)	Iodine Recovered in Gall-bladder (Milligrams)	Iodine Recovered in bag (Milligrams)	Shadow of Gall- bladder disappeared at (Hours)
Dog No 14	330	21	108	24
Dog No 16	330	37 8	111	26

Therefore it seems evident that the very peculiarities of the iodized phthalen, particularly the absorption from the intestine into the circulation, and the more or less specific excretion from the circulating blood by the liver cells, compel the recognition of the fact, that the interpretation of experiments using this dye is not as simple as it might seem

There is a further condition in the gall-bladder which has not been considered, but which certainly enters into the problem of interpretation. It is, when all is said, a gratuitous assumption, that the shadow seen in the X-ray is necessarily a shadow of the entire gall-bladder at the particular moment. If the dye in the gall-bladder were uniformly distributed throughout the gall-bladder then the shadow cast by this dye would represent the state of the filling of the gall-bladder at that particular moment. If, however, the molecules of dye were not freely movable throughout the gall-bladder content it is conceivable that a greater concentration of dye might appear in some portions of the content than in others. The shadow cast upon the X-ray plate would, therefore, not represent the actual size of the gall-bladder, but only the shadow of that portion of the bile which contained the iodine in a gall-bladder otherwise filled with bile not containing iodine, or with bile containing iodine in concentration insufficient to cast a shadow.

I believe that such conditions are actually present in the human gall-bladder in most cases. These conditions are not present in the dog's gall-bladder. If one follows the disappearance of dye from the dog's gall-bladder, and in some human cases, it is seen that the shadow does not grow smaller, the density remaining the same, but the shadow remains of the original size, while the density of the shadow becomes less and less until it disappears from view. It seems to me impossible to explain this phenomenon by any theory of elastic recoil or muscular contraction of the gall-bladder. A washing-out process, such as has been suggested, an alternate flowing in and flowing out of bile, might perhaps permit such a result.

On the other hand the usual picture in the human being is hard to reconcile with any washing-out theory. The characteristic and striking feature of

the disappearance of the dye from most human gall-bladders is that the shadow diminishes in size, retains the original density, but also preserves, in miniature, the contour of the original shadow.¹¹ I cannot imagine any method of emptying, such as muscular contraction washing out, elastic recoil, which would give this striking result, the only method which could accomplish this is the method of uniform absorption by the entire inner surface of the organ. Elastic recoil would change the shape of the shadow, washing out would disrupt its regularity, muscular contraction

would compel the final shadow to be a shadow of the infundibulum and neck of the gall-bladder.

Absorption of iodine taking place uniformly from the entire periphery of the bile contained in the gall-bladder would explain both types of disappearance of the shadow, the type characteristic of the dog, and the type commonly seen in the human being, the difference depending solely upon the physical character of the bile contained in that particular gall-bladder. Dog's bile is a comparatively thin solution. Human gall-bladder bile is a viscid colloid suspension. In thin bile the molecules of dye can move with sufficient rapid-



FIG. 2—See text



FIG. 3—See text

ity to keep pace with the rate of absorption. Molecules of dye suspended in human bile are not free to move readily. Absorption from the periphery of such a colloid suspension would permit the appearance of a shadow retaining, in miniature, the original form and original density. Such colloidal suspensions can be produced experimentally by filling the gall-bladder of the dog with dye suspended in gelatin, and such an experiment at least demonstrates the possibility of the theory. In Fig 2 is shown an X-ray of the gall-bladder of the dog filled with dye suspended in a mixture of gelatin and agar. After several hours the shadow has diminished as shown in Fig 3. The autopsy at this time reveals a gall-bladder of the original size and shape, which, on being removed from the body and X-rayed, shows an irregular dense shadow much

smaller than the actual size of the gall-bladder (Fig 4)

If absorption is constantly going on, why does not the shadow of the gall-bladder disappear during fasting? What is the effect of the fat meal? I wish to make it very clear that the explanation for both phenomena—the persistence of the shadow



FIG 4 —See text

during fasting, and the effect of food, particularly fat, is to be found in the very peculiarity of the iodized phenol phthalein, which makes it of clinical usefulness, *i e*, its absorbability into the circulation from either the intestine or the gall-bladder, and the more or less specific removal from the circulating blood by the liver cells. The dye is being brought to the gall-bladder under the conditions of fasting, just as rapidly as it is being removed from the gall-bladder by the process of absorption. Therefore there is no apparent change in the shadow during fasting. When food is introduced into the intestine, the sphincter of Oddi relaxes, the dye-containing bile runs into the intestine instead of the gall-bladder. It must be changed in the presence of food and digestive secretions into a non-absorbable form. This must be the case from the well-known fact that if the dye is given with food no gall-bladder shadow appears.

Food then, especially fat, accomplishes three things—opens the common duct, breaks the circuit of dye from gall-bladder to blood, to liver, and back to gall-bladder and changes the dye in the intestine into some form or combination such that it is now not absorbed by the intestine.

The fourth method which has been used to study the gall-bladder function is the combination of the Graham dye, with the method of biliary drainage devised by Lyon. In a recent paper Lyon¹² published results obtained by this

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method, which he believes satisfactorily settle the problem that the gall-bladder does empty through the cystic duct

Let us take the first six cases from Lyon's table, the results of which he considers entirely satisfactory, together with one case from his second table which enters largely into his discussion of his results, and let us carry Lyon's own figures on to their logical conclusion (Table II) He gives the amount of iodine found in each of his bile fractions, and also the total amount of bile recovered in each fraction. A simple multiplication gives us the total amount of iodine recovered

TABLE II

3.5 grams or 3500 milligrams dye given to each patient, in capsules. Dye contains 60 per cent iodine, therefore each patient received 2100 milligrams iodine

Case Number	Reduction in Size of Shadow	Iodine Milligrams per Cubic Centimetre		Cubic Centimetres of Bile		Milligrams Iodine Recovered		Total Iodine Recovered
		"B"	"C"	"B"	"C"	"B"	"C"	Milligrams
95096	Complete	4.2	2.5	120	210	504	525	1029
95105	"	9.6	0.42	100	300	960	126	1086
95134	"	6.4	3.2	140	500	896	1600	2496
95136	"	8.4	0.8	192	476	1612.8	380.8	1993.6
95137	"	3.4	1.3	125	400	425	520	945
95171	"	9.5	1.1	175	750	1662.5	825	2487.5
95172	½ after B D *	19.6	3.2	100	400	1960	1280	3240

Duration of drainage averaged three hours and ten minutes, although in most cases all of the "B" bile was recovered within the first ninety minutes

*B D indicates reduction in size of shadow after biliary drainage

It must first be remembered that Lyon gave each of his patients in these experiments three and one-half grams of dye, and that the dye contains approximately 60 per cent of iodine¹³. Therefore each patient received 2100 milligrams of iodine. In the first, third and fifth cases in which I have carried out these simple calculations the "C" bile contains more iodine than the "B" bile. If the "C" bile is liver bile, whence comes this iodine? In the third and sixth cases Lyon has recovered more iodine than he fed his patients. And in the last case which I have taken from Lyon's second group, the figures show that he has recovered 3240 milligrams of iodine, after giving the patient only 2100 milligrams, and in addition he states that in this case the shadow of the gall-bladder, after biliary drainage, had been reduced to only one-half the original size.

But granting the correctness of the observations of Lake¹⁴ and Lyon, that there is more iodine in the so-called "B" bile than in the so-called "C" bile, it does not necessarily follow that this iodine comes directly from the gall-bladder. If absorption is going on, it will naturally be more rapid if the gall-bladder is entirely filled with the dye, since the total surface upon which absorption is acting will be much greater. Therefore, the amount of dye

excreted by the liver in the early stages of absorption from the gall-bladder would be greater than in the later stages, but since the source of the iodine is the same, the "C" bile also contains iodine

I stated at the beginning that one of the faults I find with the theory that the gall-bladder empties a concentrated bile into the intestine at the beginning of digestion is that no one has offered a suggestion as to the purpose of such a scheme. You may, therefore, properly ask me now, what do I think would be the purpose of an absorptive function of the gall-bladder? For some unexplained reason the body carefully conserves certain of the bile constituents, the bile acids are quantitatively returned to the body, cholesterol is apparently carefully conserved. The liver is secreting constantly, but between the periods of active digestion there is no reason for bile to flow into the intestine, and possibly the resting intestinal mechanism is not in position to carry out this conservation of biliary constituents. I therefore suspect that the function of the gall-bladder is to receive and return to the body the bile which is formed during the intervals between active digestion, the purpose being to conserve these biliary elements during a period when they might otherwise be lost.

It is possible that the essential function of the gall-bladder is to carry out this same process during the months of foetal life, when no digestion is going on in the intestine. Such a concept would explain the occurrence of icterus neonatorum, the foetal bile circulation through the gall-bladder continues, but the bile pigments are not removed from the foetal circulation by the placenta. Therefore, a jaundice occurs until the introduction of food into the intestinal tract opens the papilla of Vater.

Such a concept might explain the fact that foetal blood regularly shows a hyperbilirubinemia. It would explain the physiologic hyperbilirubinemia of pregnancy¹⁵ as well as the steady increase of bile salts in the blood of pregnant women¹⁶, herein might also be found, possibly, an explanation for the well-established relationship between pregnancy and gall-stone formation.

That the gall-bladder absorbs is admitted by all, that the gall-bladder can absorb all the biliary constituents is proven by the hydrops of the gall-bladder, that the rate of absorption is very rapid is proven by the experiment I have shown you with sodium iodide. The shadow of a gall-bladder filled with 10 per cent sodium iodide, and with the common duct tied can completely disappear in an hour.

I have hesitated for a long time to insist upon my point of view in the face of so much work which seems to have satisfied everyone, because it perhaps makes little difference in the interpretation of the results whether the gall-bladder empties through the cystic duct or not. Nevertheless, the evaluation of so important a method as cholecystography, and the determination of the indications for surgical interference must, in the end, rest upon a basis of physiological fact.

If the gall-bladder empties through the cystic duct, the element of "stasis" enters into the problem of gall-stones. If the gall-bladder is an organ of absorption, gall-stones will appear, if this absorbing mechanism is incompe-

tent, as in cholecystitis, or, if the material coming to the gall-bladder is abnormal, that is, non-absorbable. And then we will have what the surgeon not infrequently sees, and what is so often found in the autopsies of people past fifty years of age—gall-stones in a perfectly normal gall-bladder.

It will then have to be admitted that gall-stones are not necessarily a product of the gall-bladder,—in fact are uncommonly a gall-bladder product, and, therefore, the removal of the stones, or the removal of the gall-bladder, will not necessarily cure the patient of his basic disease.

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TEMPORARY BILATERAL ABDUCTOR PARALYSIS WITHOUT NERVE INJURY AFTER THYROIDECTOMY *

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TO INJURE one recurrent laryngeal nerve during resection of the thyroid gland is an unfortunate accident, to injure both nerves is a tragedy. To have bilateral abductor paralysis develop post-operatively, when an immediate check on this condition of the cords has shown that the nerves had not suffered direct surgical trauma, is a disagreeable and unhappy incident, and yet, withal, endurable.

In the goitre service at The Mayo Clinic, in the last two years, during which 4249 thyroidectomies have been performed, post-operative bilateral paralysis of the cords, without injury to the nerves, has been observed in two cases, as proved both by tests of the cords immediately after operation, and by the subsequent clearing of the undesirable complication. Occasionally, despite utmost endeavors to control the technical steps of thyroidectomy, surgeons are unfortunate enough to injure one recurrent laryngeal nerve, with resultant paralysis of the cord on that side. Injury of both recurrent laryngeal nerves should never occur. I have not encountered such a complication in my service.

The most significant technical features of thyroidectomy are avoidance of injury to the recurrent laryngeal nerves and establishment of accurate hemostasis. The two steps are so intimately associated that the type of technical manoeuvre is modified to avoid the one and to accomplish the other. That is, in The Mayo Clinic it is the custom to perform subtotal thyroidectomy, with removal of the isthmus at the same time, but the operation is done as double lobectomy in one stage, with the assurance that after removal of the first lobe the nerves have not been injured, as is evidenced by the type and pitch of the patient's voice on speaking or coughing. Adequate exposure and satisfactory mobilization allow resection of the lobes, the operation is carried out entirely above the level of the trachea, and a nerve is rarely injured by the clamps which are applied for hemostasis. I believe that a nerve is injured most often following some type of hæmorrhage, either venous, or the more alarming arterial hæmorrhage which sometimes occurs from breaking off the main trunk of a vessel such as one of the inferior thyroid vessels, this is more likely to occur in arteriosclerotic persons. When such hæmorrhage occurs, one has an almost uncontrollable desire to grasp the tissues around the bleeding point with one or many forceps and this frequently results in injury to the nerves. It is a better plan quickly to press the fingers or a gauze sponge into the neck to hold the

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hæmorrhage, removing the pressure slowly and securing the single bleeding point, or if the hæmorrhage is arterial, to hold the pack tightly in the neck with one hand and go back to the source of the inferior thyroid vessel near its origin from the thyroid axis, securing the main trunk with a single ligature. Such a procedure avoids direct surgical trauma to the nerve but may result in indirect trauma from the pressure or subsequent inflammatory reaction in the neck, secondary to the necessary surgical insults to control the hæmorrhage. To proceed with resection of the second lobe without knowing the condition of the nerve on the first side, courts bilateral paralysis, although, fortunately, this occurs in only a small percentage of cases, and usually in the hands of inexperienced operators. However, to avoid one such tragedy, I am convinced that the type of manœuvre just described is most satisfactory.

Examination of the vocal cords prior to operation is always essential and should never be forgotten by either clinician or surgeon. It is entirely unpardonable to perform thyroidectomy in any case without full knowledge before operation of the condition of the vocal cords. Examination of the cords as a routine prior to operation has elicited the fact that a small percentage, about 1 per cent, of persons as they appear for the examination of conditions not related to the thyroid gland, have unilateral paralysis of the vocal cord.

In two cases, abstracts of which are appended, operation was carried out in the usual manner, that is by double resection and removal of the isthmus. Prior to operation, examination of the cords by the laryngologist showed them to be moving normally in both patients. The immediate post-operative examination likewise showed both cords to be moving normally. There was no evidence, either when the patients were on the table or immediately after operation, that the recurrent laryngeal nerves had been injured. Twelve to twenty-four hours later, aphonia, dyspnoea and difficulty and choking on swallowing called attention to a condition which was of varying intensity in both cases, depending on the amount of encroachment on the air space.

It is interesting to speculate on the reason for the appearance of temporary bilateral abductor paralysis in these two cases in which direct injury to the nerve, the usual cause, can be so definitely ruled out. The most likely explanation, I believe, is that œdema or reaction in the tissues occurred in immediate juxtaposition to the nerves, secondary to the necessary surgical trauma of mobilization of the thyroid gland. The gland in both cases was rather high-lying, and mobilization of the upper pole was perhaps accompanied by more reaction than is usual because of the difficulty in dislodging it downward. It is my practice in removing the thyroid gland to bring down the upper pole, sever it between clamps, and then, with a finger behind the gland, elevate it and at the same time press it mesially so as to control oozing from small branches of vessels not caught by the hemostats. Perhaps the finger manipulation around the inferior constrictors of the larynx and the pressure on the posterolateral tissues of the gland itself and in the immediate

neighborhood of the nerve resulted in an excessive amount of reaction with subsequent oedema and impairment of the function of the nerves. Trauma to the nerves, which is made by pinching or ligation, presents an entirely different problem from that resulting in temporary paralysis of the nerves secondary to operation.

Judd, New and Mann, in 1918, reported the results of certain experiments of traumatizing and ligating the recurrent laryngeal nerve in dogs, they found that ligation of the recurrent laryngeal nerve with linen or catgut produced just as complete paralysis of the nerve on that side as did section. Stretching of the nerve, similar to that which would be observed during operation and of the same intensity, did not impair the function of the vocal cords, but stretching over a longer period resulted in aphonia which, they believed, was due to the operative trauma rather than to stretching. Pinching of the recurrent laryngeal nerve with the hemostat produced only temporary paralysis and function was always restored, the length of time varying with the severity with which crushing was accomplished. Function was restored usually within thirty days, but sometimes as long as two months was required. These experiments seem to bear out the contention that the operative trauma and reaction in the tissues probably was the etiologic factor in these two cases of temporary bilateral paralysis. Moreover, this experience emphasizes conclusively, I believe, the contention that accurate knowledge of the condition of the vocal cords, both prior to operation and immediately after, is highly essential. The vagaries of events connected with impairment of the nerves, and partial or complete paralysis following thyroidectomy, are still sufficiently unique to encourage report whenever an unusual event of this nature arises.

The checking or testing of the cords was characteristic in these two cases, in one the cords moved normally immediately after operation and in the other they moved normally except for some sluggishness. The fixation evidently came on slowly and progressively within the first twelve hours, during which time the symptoms appeared. The height of oedema and dyspnoea was reached by the afternoon of the second day. Regression and return to normal marked the course in each case, fortunately, and this is proof of the contention that interference with the function of the nerves was inflammatory rather than the result of direct trauma. In neither case was there sufficient dyspnoea and evidence of tracheal obstruction to warrant tracheotomy, although, of course, this possibility was kept in mind constantly, and a tracheotomy set was maintained at hand. The air space had been encroached on extensively in both cases and I should not have hesitated to perform tracheotomy had cyanosis become pronounced or had stridor and labored respiration developed. Early tracheotomy following thyroidectomy, regardless of the cause of its necessity, is not nearly so hazardous a procedure or so prone to untoward complications as late tracheotomy. Indeed, it has been demonstrated repeatedly that if tracheotomy must be done for obstruction, it should be done early, before the heart has become embarrassed by long,

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continued labor against congestion, with consequent depletion of reserve. Both of the patients were placed in the oxygen chamber, which probably militated to a satisfactory outcome.

REPORT OF CASES—CASE I—A man, twenty years of age, came to The Mayo Clinic May 11, 1929. Three years previously a diagnosis of exophthalmic goitre had been made. The patient presented the usual symptoms: loss of weight (about eleven pounds), tachycardia, increased appetite, heat intolerance and insomnia. The systolic blood pressure was 150 and the diastolic 80, the pulse was 84 and the temperature 97.9° F.

The patient began taking iodine (Lugol's solution) the day of his arrival. May 13, the basal metabolic rate was +56, and May 17 it was +22. The urinalysis, blood count, and the Wassermann reaction on the blood were negative.

The patient was admitted to the hospital May 21, and subtotal thyroidectomy was done May 22. Each lobe was about five or six times the normal size and the right lobe had a retrotracheal projection. Double resection with removal of the isthmus was done, leaving glandular tissue on both sides amounting to about half of a normal-sized lobe. The pyramidal lobe was well developed and was removed. The muscles were not cut. The pathologic report was hypertrophic parenchymatous thyroid gland with thyroiditis, graded 1.

Following operation there was no unusual reaction, the temperature the following day rose to 101° F and the pulse to 124. Immediately after operation both of the cords were moving but the laryngologists noted that there was sluggishness on both sides. Twenty-four hours after operation the patient began to have difficulty in swallowing, but there was no cyanosis or difficulty in respiration. Examination of the cords, however, showed marked œdema, especially on the right side of the glottis, and both cords appeared to be fixed. The left cord was abducted, the right cord was not satisfactorily visualized. The patient was put in the oxygen chamber and his course was progressively forward from that point. The pulse and temperature did not change markedly and two days later, on examination the œdema was clearing up, the cords were visible and moving slightly, and the breathing space was sufficient. The patient's condition progressed favorably and he was dismissed from observation June 17, at which time both cords were moving normally.

CASE II—A man, thirty-three years of age, came to The Mayo Clinic June 11, 1928, because of weakness, nervousness and loss of weight (about twenty-three pounds), and a two weeks' history of palpitation and dyspnoea on exertion, and exophthalmos. A diagnosis of exophthalmic goitre was made and June 12, the patient began taking ten drops of iodine three times a day (Lugol's solution). The basal metabolic rate was +46.

The patient was admitted to the hospital June 19, and June 22, subtotal thyroidectomy was done. The lobes were about four times their normal size. Double resection and partial removal of the isthmus was done, with preservation of glandular tissue on both sides amounting to about a fourth of a normal-sized lobe. The muscles were not cut. Pathologic examination showed a hypertrophic parenchymatous thyroid gland.

Immediately after operation both cords were seen to be moving normally. The following day difficulty in swallowing developed, as in the first case, and on laryngeal examination movement was not visualized in either cord. The laryngologists reported that both cords were fixed but sufficient breathing space remained. There was no difficulty with the voice, with coughing, or with swallowing until twelve hours after the operation. It was believed that the late fixation was the result of hæmorrhage or œdema along the trunk of the nerve. The following day the laryngologists reported that the cords looked wider, and that they were apparently about 50 or 60 per cent normal. Two days later, the breathing space was wider. The patient made good progress following this and he was dismissed from observation July 10, at which time the cords appeared to be normal.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

STATED MEETING HELD MAY 8, 1929

The President, DR EDWIN BEER, in the Chair

FASCIA LATA TRANSPLANTATION FOR THE CURE OF VERY LARGE POST-OPERATIVE VENTRAL HERNIA

DR WALTER M BRICKNER presented a rather stout man, forty-five years of age, who had been operated on six years ago for "chronic appendicitis" Two weeks after leaving the hospital the man noticed a hernia in the scar Six weeks later the same surgeon attempted an operative repair but the hernia soon recurred Since then the patient had had intermittent attacks of abdominal pain and vomiting, lasting two to three days These attacks at first were several months apart but recently had become more frequent

When first seen by Doctor Brickner, January 29, 1929, he was just getting over one of these mildly obstructive attacks His abdomen presented a six-inch longitudinal scar over the right rectus muscle, beneath and chiefly to the outer side of which there bulged a large, irreducible hernia In circumference and in bulk this hernia would almost fill a derby hat Abdominal palpation was otherwise negative and so was the finding of a gastro-intestinal X-ray examination

Operation was performed February 4 under spinal anæsthesia The scar was excised by free longitudinal incision The large sac was adherent to the abdominal aponeurosis on the right side and had to be dissected from it There was a very extensive deficiency of rectus muscle and aponeuroses Small intestines were found densely and extensively adherent to the sac One loop of gut was sharply angulated by adhesions and it was released by dividing these No other adhesions were disturbed Only that portion of the sac which was not adherent to the intestines was resected, and the peritoneal opening was immediately closed The hernia was then reduced into the belly The lower half of the hernial opening was closed by kangaroo tendon sutures approximating the only layer of aponeurosis that was here present Closure of the upper half was accomplished by longitudinally incising the anterior sheath of the left rectus and reflecting the inner segment over to the right side to effect approximation There was thus accomplished a complete closure with a single layer of aponeurosis The deficiency of the second layer, however was very large—occupying an area seven inches long and five and a half inches wide A fascia lata transplant, eight inches by six inches, was then cut from the outer and anterior aspect of the right thigh, through a long incision This transplant, which included much of the tensor fasciæ femoris, was stitched snugly over the defect with two rows of chromicized catgut sutures Both skin wounds were closed with running silk sutures Hemostasis was perfect in both wounds, and only a few vessels required ligation

Perfect primary union took place throughout The man was kept in bed nineteen days The abdominal wall now appears solidly repaired He has no pain, or any other abdominal symptom and he suffers no inconvenience

PERFORATED GASTRIC ULCER

whatever from the loss of so large a portion of his fascia lata. Indeed, it is of interest to observe in these cases that so much of this aponeurotic covering of the thigh muscles can be removed without causing any functional disturbance, even when the tensor fasciæ femoris is also sacrificed.

PERFORATED GASTRIC ULCER, CLOSURE MULTIPLE DUODENAL ULCERS PYLORIC TOMY POST-OPERATIVE VENTRAL HERNIA, HERNIOPLASTY

DR WALTER M. BRICKNER presented a man, thirty-two years of age, who was admitted to his service at the Hospital for Joint Diseases December 28, 1927, with symptoms of perforated gastric ulcer. At operation a small hole was found in the anterior wall of the stomach about an inch and a half from the pylorus. In the upper abdomen there was but a small amount of clear gastric fluid, which was removed by suction. The perforation was closed with two layers of absorbable inversion sutures. The wound, through the right rectus muscle, healed *per primam* and on the fourteenth day the patient was discharged, in good condition, to the Out-patient Department for further observation.

Soon, however, he began to suffer from epigastric pain after eating, with heart-burn and vomiting, so that about two months after his discharge he was sent back to the hospital with a diagnosis of duodenal ulcer. This was confirmed by roentgenological examination which showed, in all films, extensive filling defects involving the lesser curvature of the duodenal cap almost from its base to its apex. The beginning and mid-portions of the second part of the duodenum were dilated. The stomach was normal in size, shape and position and emptied in three hours.

At operation, March 30, 1928, again through the right rectus muscle, the site of the gastric perforation showed only a fine scar. The first portion of the duodenum, however, was now found much thickened and highly inflamed. This portion of the duodenum and a considerable portion of the stomach (certainly including all of the antrum pylori) were resected, and a retrocolic gastrojejunal anastomosis was made by the Polya method, absorbable sutures being used throughout. Section of the duodenum showed two discrete, inflamed ulcers.

On the sixth post-operative day the patient was vomiting and the skin wound had to be reopened at its lower angle to evacuate a hematoma. Thereafter the man did well and was discharged, healed, May 1, 1928.

He continued under close observation in the gastro-intestinal department of the dispensary and in the surgical follow-up, and for the succeeding ten months he reported himself as feeling well, with only occasional gastric discomfort without vomiting, and with considerable gain in weight. He had, however, an incisional hernia the length of the scar.

Returning home from his work on a cold night about March 1 this year he had abdominal pain and vomited after eating, and this vomiting continued until he was readmitted to the hospital two weeks later. He had noticed no blood in the vomitus nor had his stools been abnormal in color, but he had lost four pounds in weight. Under rest in the hospital, however, the pain and the vomiting ceased at once and during a fortnight of observation the patient was eating a quite liberal diet with no distress whatever. Roentgenologic examinations showed the remnant of stomach as a well-filled tubular organ lying wholly to the left of the mid-line, a well functioning gastrojejunal stoma almost three centimetres in diameter at the right interior angle of the

stomach, promptly initiated emptying of the stomach, which was complete in three hours, no evidence of a marginal ulcer

The man thought the hernia was chiefly responsible for his symptoms, and he requested that this be repaired

For this purpose he was operated on again March 30, 1929. The skin scar, to which the peritoneum was adherent, was excised and the abdominal cavity was entered. Extensive adhesions were exposed. Because the patient had had but a short period of pain and vomiting in a year and had been free from symptoms for two weeks while resting in the hospital, and because the X-ray examinations gave no evidence of an ulcer or a mechanical defect, Doctor Brickner decided not to separate these extensive adhesions to explore the anastomosis, but to be content with the purpose of the operation—the repair of the hernia. The peritoneum and the posterior sheath of the rectus were easily approximated. In the lower angle of the wound the anterior sheath of the rectus was reunited under slight, but not undue tension, with kangaroo tendon sutures. The greater part of it, however, could not be closed except, perhaps, under great tension. Accordingly, two longitudinal releasing incisions, about four inches long, were made, one on each side of the wound, through this aponeurosis, which then at once could easily be sutured.

Primary union followed, and a solid abdominal wall resulted. The patient was discharged from the hospital seventeen days after operation, free from symptoms.

This man has, or had, then, two oval defects in his aponeurosis, made by the releasing incisions, through which the rectus muscle was left exposed. As in the case of the previously presented patient with the large transplant from the fascia lata, this defect appears to cause no disturbance whatever.

The patient has not yet returned to work and has been until now in a Convalescent Home. He reports himself a "feeling fine." The tests of time and of work are yet to come.

DR SEWARD ERDMAN added his testimony to Doctor Brickner's demonstration of the repair of the mid-line hernia. He understood that Doctor Brickner made use of Doctor Gibson's method of incising the fascia laterally so as to release it. In a number of Doctor Erdman's cases this has been very successful and he felt that one who has seen the results which can be accomplished by a releasing incision in the sheath of the rectus will agree that it is very satisfactory. While Doctor Erdman has used this method more in the epigastric region than in the lower abdomen, on two occasions he has used it below the umbilicus. The defect left in the rectus sheath after operation, he agreed, is sometimes rather alarming to look at, but as in Doctor Brickner's case, it does not seem to impair the strength of the muscle wall. While it is true that the muscle is left exposed at the site of the releasing incision, yet the defect eventually fills in with new fascia.

CONSERVATIVE SURGERY IN CHRONIC OSTEOMYELITIS

DR WALTER M. BRICKNER said that last year he presented before this society some cases (ANNALS OF SURGERY, February, 1929) intended to demonstrate the value of conservative surgery in *chronic* osteomyelitis. They were to show that in cases, for example, with sinuses or soft-part abscess,

rather than at once attack the bone by a more or less radical osteotomy, it is wiser to wait (so far as the bone itself is concerned) until a sequestrum is fully formed, and then merely to remove the sequestrum or sequestra even though it leaves overhanging bone. Contrary to much teaching, the cavity in the bone, when rid of its dead content, often heals, and stays healed, without requiring the familiar "saucerization."

Tonight he wished to illustrate by two cases from among many the value in another phase of osteomyelitis—the chronic bone abscess—of a simple conservative operation which for more than ten years he has advocated and practiced with uniform success, *viz.* drainage through a small drill hole, under nitrous oxide narcosis. This little operation works equally well whether the abscess is medullary or in the bone substance. Of course it is not intended for an abscess that is already discharging through the bone.

CASE I—A lad, now about twenty years of age, was operated on in 1922 for what was probably a pyarthrosis of the left hip and osteomyelitis of the ilium, in 1926 for osteomyelitis of the left radius and in 1928 for osteomyelitis of the right humerus.

He came under the reporter's care in 1927 because of recurring abscesses and sinuses in the scars about the left hip, through which, occasionally, a sequestrum had escaped. X-ray films (Fig 1) showed complete bony ankylosis of the hip and the changes produced by an extensive osteomyelitis of the ilium.

There was evident no gross process needing attack. Two small areas of erosion appeared to contain minute, incompletely formed sequestra. It was decided to treat this case conservatively, draining abscesses as they appeared and allowing such sequestra as formed to escape spontaneously if they would. Accordingly, abscesses have been opened about four times in the past two years, twice with the escape of small bone fragments. The sinuses have healed and no abscess has formed for several months.

In December, 1928, in the follow-up clinic of the Hospital for Joint Diseases, the boy complained of persistent pain in the upper part of the *left* arm, worse at night. There was no redness, swelling or fever, but there was pronounced bone tenderness four and one-half inches below the tip of the acromion. A diagnosis of bone abscess was made. This was confirmed by X-ray examination, which showed an enlargement of the medullary cavity at the



FIG 1—Bony ankylosis of hip, with iliac osteomyelitis. (Note the two minute incompletely formed sequestra.)

level of tenderness, with encroachment, by bone growth, on the medulla above and below (Fig 2) Through a small anterior longitudinal incision centred four and one-half inches below the acromion, the humerus was exposed and entered with a one-eighth inch drill. There escaped a dram or more of thick pus in which the staphylococcus aureus was found on smear and culture. A rubber dam drain to the bone was inserted and the wound was sutured. The pain ceased promptly, the drain was removed in three days, the wound closed, and there has been no recurrence of symptoms.



FIG 2—Abscess of humerus to osteomyelitis of ilium (Same patient as in Fig 1, one year later)

CASE II—Another lad had been operated on several times for osteomyelitis in the lower third of the right femur. He was in the Hospital for Joint Diseases for several months in 1928–1929 with a series of soft-part abscesses—in each arm near the axilla, in the region of the left hip and buttock, and beneath the fascia over the affected femur. Last September, in the hospital, he complained of pain in his left knee and exhibited tenderness in the upper part of the patella. X-ray films showed here a distinct small, oval area of erosion—a bone abscess (Fig 3). At operation, this cavity was found to contain not pus, but broken-down bone and granulation tissues, which were removed and which yielded living staphylococci aureus. The wound healed and there has been no recurrence of local symptoms.

Discharged from the hospital in March 1929, the boy complained in April of pain in the upper part of his left arm, severe at night, without swelling, redness, or rise of temperature. There was exquisite bone tenderness four inches below the tip of the acromion. A diagnosis was made of chronic, probably medullary, bone abscess, which was confirmed by roentgenogram (Fig 4). The same operation as in the preceding case was performed on this boy two weeks ago, evacuating thick pus, containing living staphylococci, through a one-eighth inch drill hole. Because the X-ray film showed bony septa in the abscess cavity, a second drilling was made in the lower compartment but no further pus escaped—the cavity was single. The skin wound has shown some infection but is now healing. The pain has ceased.



FIG 3—Chronic abscess in patella (Case II)

It was mentioned in these cases that the organisms were living, because very often these chronic bone abscesses are sterile. Simple drill drainage of chronic bone abscesses, in which the patient is afebrile or subfebrile, works as well when the bacteria are living, but probably attenuated, as when they are dead or have disappeared. In those occasional, more acute or more active cases, with fever, free drainage should be provided.

DR FRANK WICK BIRKMAN said that in Bellevue Hospital, many of the patients upon whom they operated some years ago, before they took up conservative methods, are still suffering, for the scars which are adherent to the bone, break down frequently and in three cases the individuals had fractures, which were necessarily compounded. Since they had taken up conservative treatment a marked improvement in the results could be seen. Most of their cases had secondary operations, a great many of these being for cavities in sclerosed bone. In the last two or three years they have been treating these by means of the Ott technic—removing the root and edges of the cavity, and the skin being allowed to drop in as far as it would. This was dressed after packing the cavity with vaseline gauze and a circular plaster casing applied. This was left on until the smell became unbearable. He felt that while this method is not esthetic, the results were good though the procedure seemed to him to be unsurgical. In cases where sequestra formation had taken place, Doctor Beckman agreed with Doctor Brickner that a sequestrum should not be removed until it had entirely separated and even went so far as to express an opinion that it should not be removed until nature had removed much of it by means of phagocytosis. At Bellevue, they have found that the longer a sequestrum is left, the easier it is to remove through a small incision, and frequently it can be teased out without removing any more of the cortex of the bone. The more one does to the bone, the more scar tissue will form, resulting in lessening the blood supply. In those cases in which there are large sclerosed bones, especially if there is no subcutaneous tissue over them, the scars break down continuously. If the case can be brought through with small scars, the after-results are very much better in every way.

DOCTOR BRICKNER, in closing the discussion, said that chronic bone abscesses are not at all uncommon in cases of osteomyelitis and are not rare in individuals who have not been known to have had osteomyelitis. It is one of the things to think of when an individual has persistent localized pain. Indeed,

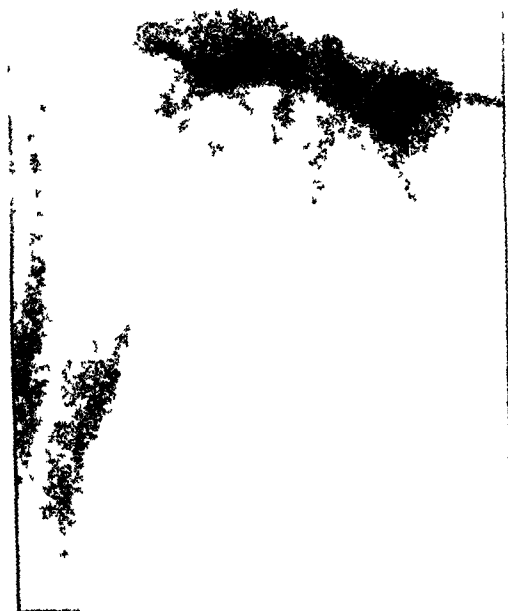


FIG. 4.—Chronic medullary abscess of right humerus. (Same person as in Fig. 3.)

localized pain, often worse at night, is usually the only subjective symptom, commonly there is no fever, swelling, or redness. Localized bone tenderness is the only objective physical sign, and the diagnosis is confirmed by X-ray examination.

He felt that there was another question worth discussing and that is, do these chronic bone abscesses represent continuing infection, or were they present in one phase or another at the time of the original infection? He was inclined to think they were. When, in acute osteomyelitis of one bone, a patient becomes infected with the organisms he often gets a shower of bacteria in other bones, but these sometimes become attenuated and often only long after does local pain reveal the presence of a long-latent distant pus collection. Curiously, at a time when the abscess first gives symptoms the pus may be found sterile. If systematic X-ray examination were made of all the bones in cases of osteomyelitis one would probably sometimes find—in fact, he has found—foci in other bones giving, at the time, no symptoms at all. Primary infection seems also the best explanation of chronic abscess in the original bone which, though residual from the acute osteomyelitis, first gives symptoms fifteen, twenty, or even forty years later.

TREATMENT OF POTT'S FRACTURE, WITH PERSISTENT DEFORMITY

DR SETH MILLIKEN presented a woman, thirty-seven years of age, who during the evening of February 9, 1929, slipped, injuring the left ankle. She was seen by a competent surgeon who reduced a fracture in the left ankle and applied splints. X-ray the next morning showed renewed displacement. A second reduction was attempted and again splints were applied. The displacement still persisting she came under the care of the reporter.

On the morning of February 13, under anæsthesia, a Steinmann nail was forced through the lower posterior border of the os calcis. The nail was then attached to a cord laid through a pulley elevating the leg at an angle of about forty degrees above the level and fifteen pounds attached to the end of the cord, with the entire weight of the leg from below mid-thigh hung on the Steinmann nail. The lower half of the Gatch bed was sufficiently elevated to support the patient's buttocks and prevent sliding downward.

X-ray taken February 14 showed improvement in the position. February 15 showed partial reduction. February 16 showed complete reduction with fragments in apposition and the lower margin of the tibia restored to normal alignment.

By February 20 all swelling of the foot and ankle had disappeared and the patient could voluntarily move the ankle through a range of about ten degrees. The traction was reduced to ten pounds and the position lowered so that the lower part of the thigh touched the bed. March 13 the nail was removed after applying two lateral and a posterior splint from the toes to the knee. March 15 both wounds were scabbed, no discharge. The patient was allowed to go home on crutches.

April 11 splints were removed, fracture seemed perfectly united and firm. As soon as splints were removed patient had voluntary motion between twenty-five and thirty degrees at ankle without pain. The inner nail hole

FUNCTION OF THE GALL-BLADDER

was entirely healed, the outer hole showed small granulation. She could rest the weight of the leg on the floor without pain.

April 26 the patient telephoned she was walking with a chair in front of her without pain.

May 3 she walked without crutches, had twenty-five degrees range of motion in ankle-joint. There is still considerable œdema of leg and foot but muscle tone is considerably regained. Patient is shown twelve weeks from the time the nail was inserted.

This patient was shown because of the bad deformity caused by the fracture, the great difficulty in maintaining the reduction of the fragments and to show a method of obtaining a satisfactory reduction and result without suffering to the patient.

The reporter believed the disability resulting from an incomplete reduction in this type of fracture to be permanent. This method, however, in two cases has given perfect reduction and function.

The continuous motion of a joint in which the articular surfaces are involved in the lesion is of great importance in obtaining satisfactory function after the fragments are reduced.

FUNCTION OF THE GALL-BLADDER

DR JOSHUA E. SWEET read a paper with the above title, for which see page 939.

DR CHARLES E. FARR, in commenting on the paper, said that he had never yet found at operation an entirely empty gall-bladder. It is not rare to find the gall-bladder somewhat relaxed, as if the tension were moderately low, but there is nothing to suggest a contracture or spasm of a muscular organ. Every surgeon knows that to empty the gall-bladder even with a normal cystic and common duct requires considerable pressure, far beyond the possibilities of the thin-walled normal organ.

Doctor Farr questioned the sudden emptying of the gall-bladder after the ingestion of the fat meal: first, because at operation even after a hearty meal the gall-bladder is not found empty, and second, because X-rays do not reveal a stream of the opaque dye flowing into the common duct and duodenum. He believes that Doctor Sweet is correct in considering the gall-bladder largely an organ of absorption.

DR SEWARD ERDMAN said he had always believed the gall-bladder filled and emptied, and referred to an article published several years ago in the *Journal of the American Medical Association* on some experiments by Japanese investigators which seemed very convincing. The statement, he thought, was made at that time that while operating on the human gall-bladder, with a duodenal tube in the duodenum, the surgeons had seen the gall-bladder empty, when magnesium sulphate solution was injected through the tube as is done in the Lyon's test. Furthermore, when faceted gall-stones of a uniform size, color and consistency are found in the stools of patients, after

an attack of gall-stone colic, and when at operation, a few days later, the gall-bladder is found to contain identical gall-stones, it seems logical to conclude that stones have passed from the gall-bladder to the intestine

Clinically it is known that removal of the gall-bladder and its stones, in such cases, cures the patient in nearly every instance

If it be assumed that gall-stones form primarily in the hepatic ducts, and pass thence into the gall-bladder, why does cholecystectomy cure the patient?

EDITORIAL ADDRESS

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THE PROBLEM OF RHINOPLASTY¹

By HOWARD L. UPDEGRAFF, M D

OF HOLLYWOOD, CALIF

THE problem of rhinoplasty is one of increasing interest because of the number of successful cases yearly being reported. With the thought of further simplifying the necessary procedures this paper is presented.

Historically, 1918 furnishes us with a dividing line. In earlier years, Tahiocozzi,¹ Nelaton, Ombridanne and many others, without the benefit of anæsthesia, asepsis, and adhesive plaster, had developed the idea of the forehead flap. By 1918 the influx of war facial deformities had created a renewed interest in rhinoplasty, and caused the elevation of plastic surgery into a specialty *per se*, *reconstructive* surgery.

The etiological factors necessitating rhinoplasty include lues, cancer, lupus, radium and X-ray burns, cancer pastes, plasters and acids, trauma, paraffinomas and infections.

The preliminary considerations involving successful operative procedure depend first on etiology. The amount of involvement of tissue and the condition of the remaining available reconstructive base demand consideration. If one or both canthi are involved the question of lachrymal duct treatment



FIG 1.—Typical case applying for rhinoplasty
Lupus vulgaris

or obliteration arises. Sex is important in that the mode of dressing the hair in the female oftentimes is the deciding factor of changing an uncoverable defect of the nose to a concealable one of the forehead. Incidentally which way the hair is parted oftentimes decides the direction of the flap when the nasal defect is centrally located. The psychology of the patient is vital. A poor result will please one—an excellent result will offend another. The glandular syndrome as reflected by temperament may be an index of not only the patients' cooperation but their healing power.

The type of skin is one of environment and age. A majority of cases are those of cancer and lupus age or past. A high forehead with receding temple hair is a distinct advantage in that the flap can be cut high and curved,

* Presented before the Hollywood Academy of Medicine, July 2, 1929



FIG 2—Cancer paste for supposed malignancy

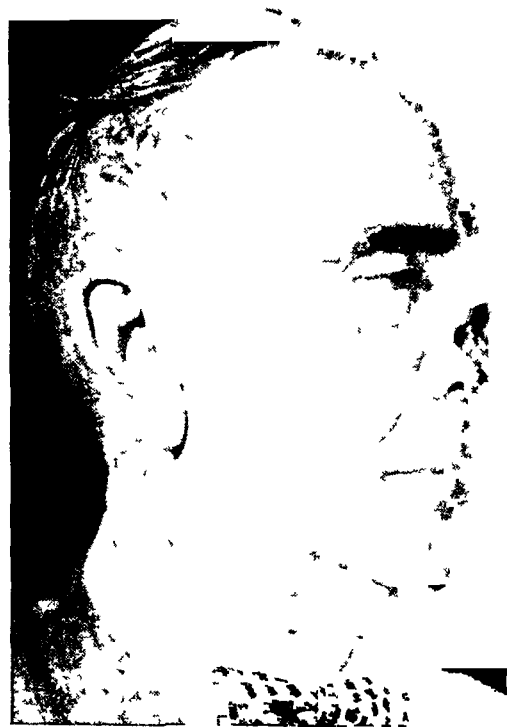


FIG 3—Epithelioma—surgical removal. Seemingly small nasal opening due to falling in of tissue, most of which unavailable for reconstruction



FIG 4—Same case as Fig 1. Note amount of septum deficiency



FIG 5—Same case as 2. Cancer paste has destroyed left nasal bone and lachrymal duct



FIG 6—Same case as 3. Following surgical removal of epitheliomata



FIG 7—Plaster cast of case in Figs 1 and 3. Shows tinfoil on forehead designating amount of forehead skin necessary to form nose



FIG 8—Note amount of canthus involvement. Same case as Figs 2 and 5



FIG 9—Note amount of tissue necessary to supply deficiency as indicated by modeling clay. Same case as Figs 3 and 4

and skin taken from the temple area is more acceptable without hair as this portion of the flap forms the nose. At least the bald-headed man has one thing for which to be thankful.



FIG 10—Glue cast of preceding cases 1, 4 and 7. Shows leather flap folded to mold columella and additional piece to demonstrate Wolfe graft lining.

The amount of the nose to be reconstructed may seem at first glance to be small (Fig 1). Examination may reveal much thin scar tissue useless for attaching a flap. The nasal arch, if persistent and high, may spoil the line of the new nose to the extent that partial removal is advisable. The septum is not of great moment as the flap is not attached to it except at the columella and the profile deficiency (Fig 4) can in large part be supplied by the thickness of the free graft used to line the flap as advocated by New.² If portions of both alæ can be preserved and utilized the attendant alar flap is a very acceptable contribution.

The mental preparation of the patient is of importance as the average rhinoplasty will take three or four stages, extending over a period of three months. The patient has no way of knowing or comprehending the amount of personal time given to detail by the surgeon. Consequently, the thought of the financial outlay necessary for hospitalization influences many to the use of prosthesis or further attempts at healing.

A patient is naturally hesitant in starting on a prolonged period of hospitalization without some reassurance that the etiological factor will not recur. In lues, specific treatment will be of value but not of necessity, inasmuch as the necrotic bone and septum are not replaced but rather the defect covered. Again, the tertiary stage of which the caries is indicative is not a stage necessarily where absence of skin healing and lowering of resistance to infection are especially evident. Total rhinoplasties on luetic patients with a two plus Wassermann and no treatment



FIG 11—Crinoline may be used instead of leather to make trial flap on glue cast.

have been done successfully by Sheehan.³ Lupus vulgaris cases have a good chance for permanent recovery according to Roen,⁴ of Hollywood, through a special diet and a calcium formula called "Mineralogen." The cancer cases are problematical, but usually appear for operation with the deficiency from cancer removal rather than from the growth.

The request of an old photograph of the patient before the deformity took place serves not only as a psychological stimulant, but as an aid for modeling clay replacement on the plaster cast made of the patient as a basis for reconstruction.

The cast is made with the patient in a recumbent position. United States Gypsum No. 1 plaster is better and cheaper than dental plaster. When the mold is made a glue cast (Fig. 10) should first be made before the final plaster cast. The glue cast (White Glue Composition, Young Novelty Co., of Boston) serves as an actual model which can be sutured, using thin leather for the flap after measurements have been determined from the modeled nose on the plaster cast. Ivy⁵

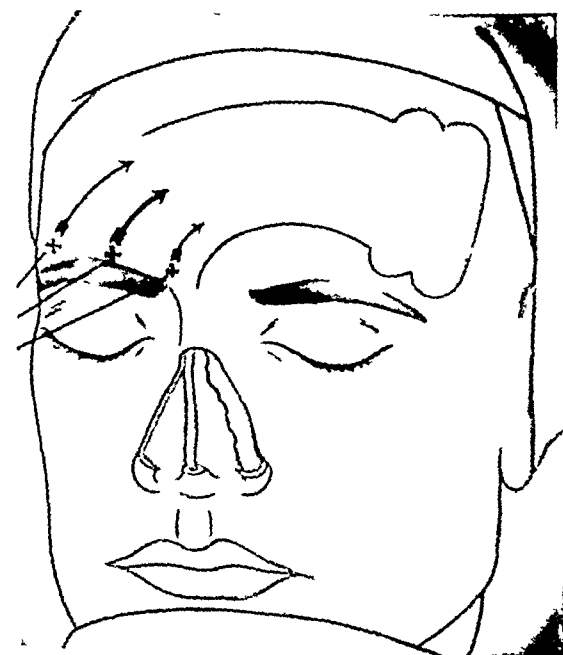


FIG. 12—Flap is reversed, depending on location of deformity.

following Blair's suggestion, presented a suggested set of measurements for the average flap which may be modified to suit. Smith⁶ in a late book presents a similar schematic flap with plan for figuring measurements. Smith is also responsible for an important axiom that "reconstructive surgery is one field of endeavor in which procrastination is not a thief of time."

First Stage—Once the style and size of the flap having been determined by actual planning on the glue model a tin-foil pattern is worked from the leather flap and traced (methyl-violet 5 per cent in alcohol) on the forehead. Due regard is paid to blood and nerve supply (Fig. 13) in that the nasal, frontal and an-

FIG. 13—Flap outlined. Arrows demonstrate blood supply. Nasal, frontal and anterior temporal arteries.

terior temporal arteries are preserved to supply the base. The flap is now incised under local or general anæsthesia, care being taken not to cut through the frontal or temporal muscles. The anterior temporal artery at the distal

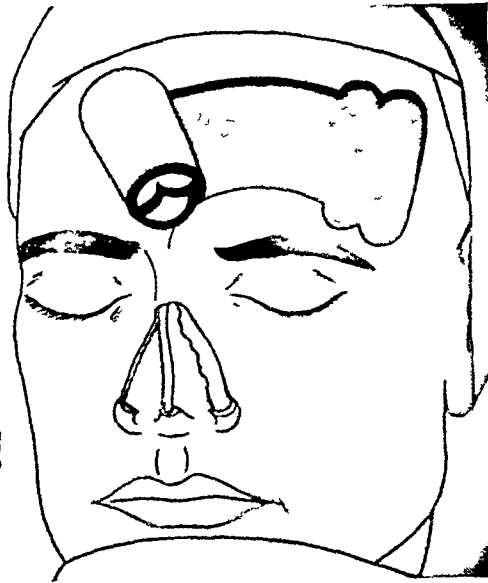


FIG 14—Flap raised and rolled back to allow planting of Wolfe (or Thiersch) graft

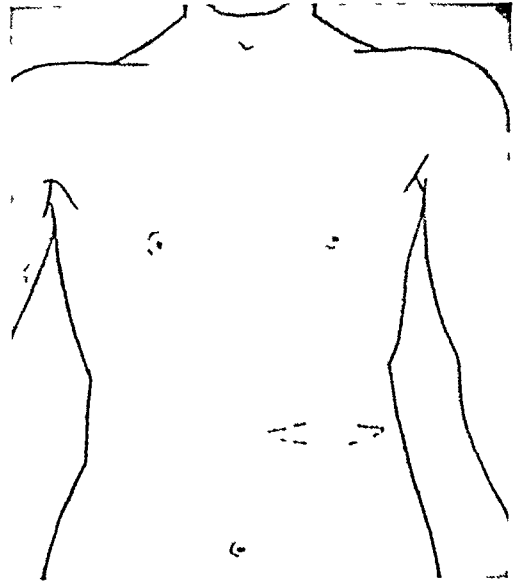


FIG 15—Extra closing incisions for lining graft plotted on abdomen

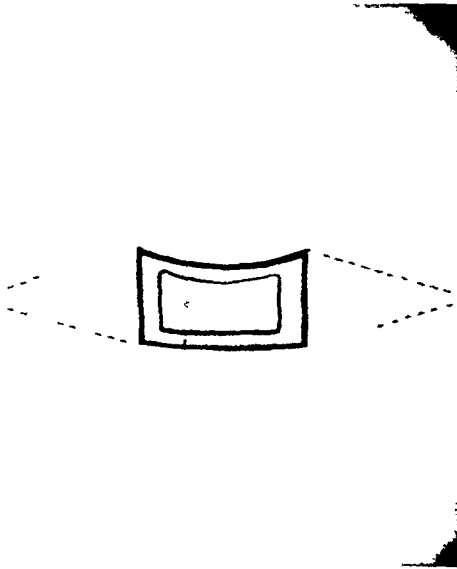


FIG 16—Graft when cut shrinks on sectioning. Dotted lines indicate additional tissue to be removed to insure closure. Graft when removed is placed cut side up on pith wood board and stretched to normal size with counter sunk pins at edges. It is then cut down to desired thickness with sharp curved scissors or large scalpel. Graft should be kept warm and dry until ready to plant under flap. If large and thick graft perforating will aid viability.

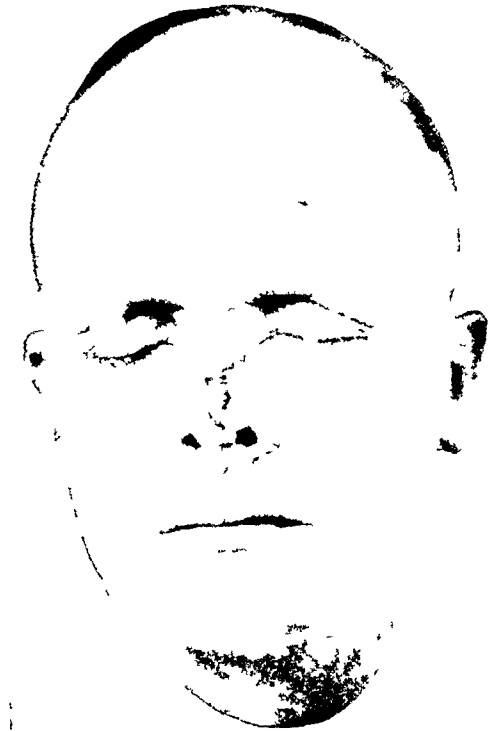


FIG 17—Same as previous cases. Ten to fourteen days after first stage operation. Wolfe graft has been inserted under flap which has been elevated and resewn.

RHINOPLASTY



FIG 18—Wolfe graft inserted and flap resewn. Note necrosis distal end of flap due to hematoma from cut anterior temporal artery. An allowance for such contingency is usually made in the original planning of the flap.



FIG 19—Flap has been sectioned completely, but only part necessary for insertion of Wolfe graft elevated. Xeroform gauze inserted for aeration of flap and graft.

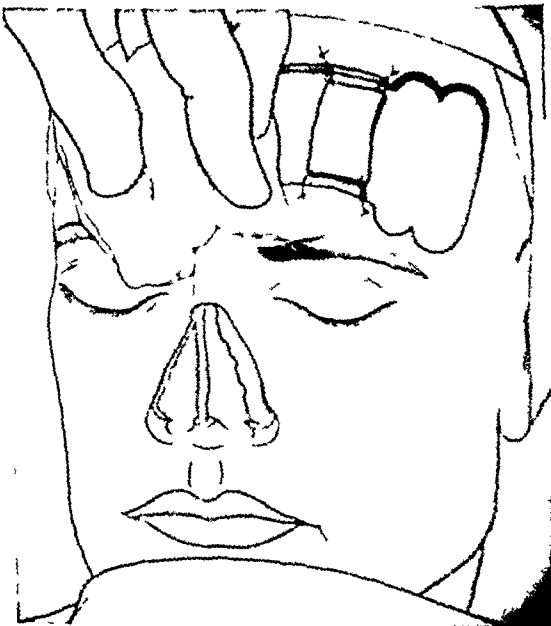


FIG 20—Graft when cut shrinks to half size. Should have all fat and subcutaneous substance removed before suturing to clean dry surface. Note that epithelial side is down.

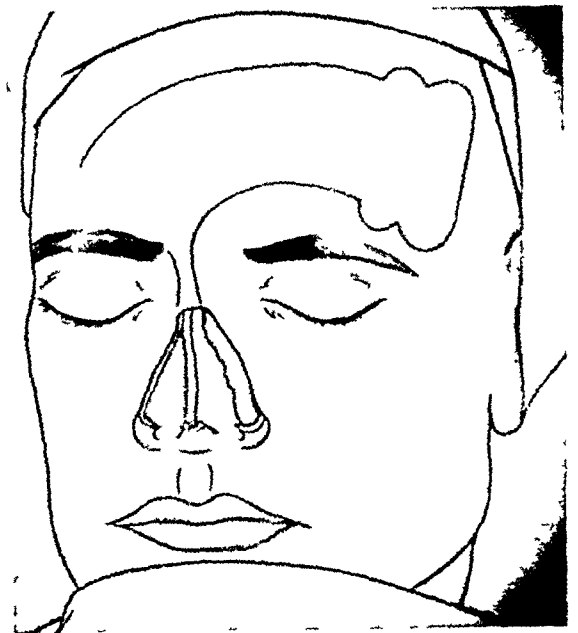


FIG 21—Flap and graft have grown together and are ready to be returned to nasal aperture.

portion of the flap may or may not be sectioned at the discretion of the operator

Various men differ, some advocating waiting four to seven days, others section the anterior temporal artery at once. The problem is purely one of the length, size and condition of the flap and the size and position of the lining graft to be inserted.

Practically all authorities at the present writing are unanimous in agreeing that the delayed flap as suggested by Blair⁷ is the method of choice and, accordingly, the flap after elevation (Fig 14) is resected to the forehead for a period of seven to twenty-one days.

The problem of lining the nose is of as much importance as is the supplying of a covering flap. While the lining does not take on the physiological

functions of the missing mucous membrane, it, however, greatly prevents contracture and supplies early healing. The question of a lining, whether of Thiersch or Wolfe graft, for the upper portion of the nose not taken care

of by the infolding of the distal portion of the flap to form the necessary alæ and columellæ, is entirely one of supplying the deficiency thickness. If a good amount of septum is present along with available alar tissue and columella, a Thiersch graft lining of the flap will supply the need. If the nasal tissue is totally gone or unfit for use, a thick full-thickness graft from the abdomen (Figs 15 and 16) grown to the flap will give several millimetres raise in the final result and supply necessary strength to build a new columella and ala nasæ. The general background of the patient may be such as to make advisable only the outlining of

the flap—omitting incision of the anterior temporal artery and elevating only the portion of the flap necessary to insert the graft for lining (Fig 19). Conservatism during the first stage of rhinoplasty when suggested by surgical judgment usually pays accrued dividends.

A free full-thickness graft (Fig 20), used for lining, is best protected from failure by careful expression of any blood clots between it and the

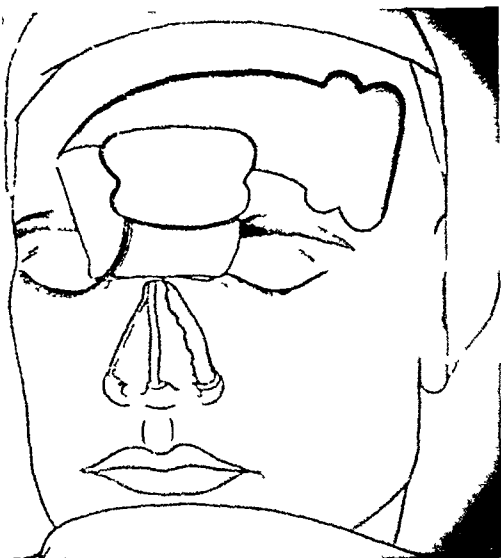


FIG 22—Note graft adherent to flap with epithelial side out to form lining of nose

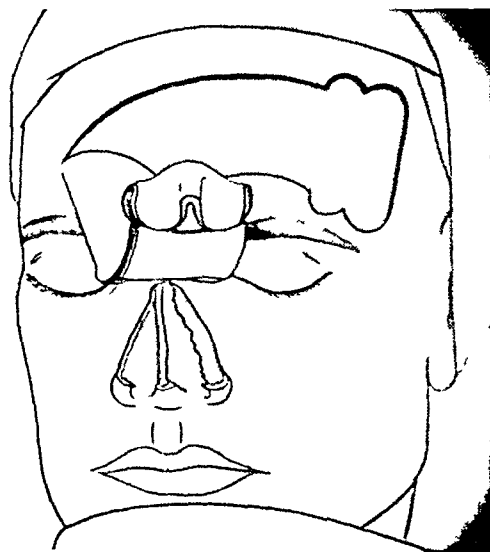


FIG 23—Distal portion of flap folds to form columella and ala nasi

flap. Small rubber drains removed in twenty-four to forty-eight hours if hemostasis is not satisfactory are advisable. The flap, including graft (Fig 21), is resutured to the forehead with No 7 black, twisted, paraffined silk, which passes through the flap, graft and forehead skin. It is then dressed with 3 per cent xeroform ointment and sea sponge moderate pressure for five to seven days. At the same time the forehead flap is prepared, the necessary work on the nose such as removal of old crusts, infected areas, scar tissue, and excess nasal arch is done. A proper columellar base is assured, utilizing some of the upper lip if necessary as the new columella of the flap must have a secure anchorage. It is also important that the airways be subjected to such measures as will insure their functioning properly following the second stage.



FIG 24—Tube down forming new columella and ala nasi. Note Wolfe graft on forehead to supply tissue left for nose.



FIG 25—Note amount of profile deficiency supplied by tube.

Second Stage—Seven to fourteen days later (with thirty as a maximum), the graft having taken, the flap is again elevated and brought down over the nasal area (Fig 22). The aperture edges are sectioned at right angles and undercut sufficiently to prevent inversion of the scar. The columella and ala nasæ are formed (Fig 23) and sutured with catgut. The flap is first attached at the glabella and then with interrupted sutures to the aperture. No effort need be made toward tubing as it will tube itself in a few days. Hæmorrhage from the tip of the flap during operation is an aid to preventing congestion and an index of viability.

Hemostasis throughout is best controlled by pressure and hemostats rather than sutures, especially in the line of union. Rubber nasal splints are inserted and changed as necessary to give open air passages and keep alæ dilated. The forehead skin deficiency may be supplied by a free full-thick-



FIG 26—Frontal view of same case as Fig 25
Forehead is free granulating surface



FIG 27—Flap is sectioned at proximal portion of
lining of flap



FIG 28—Flap has tubed itself and is consider-
ably shrunk



FIG 29—Flap extended and sutured

RHINOPLASTY

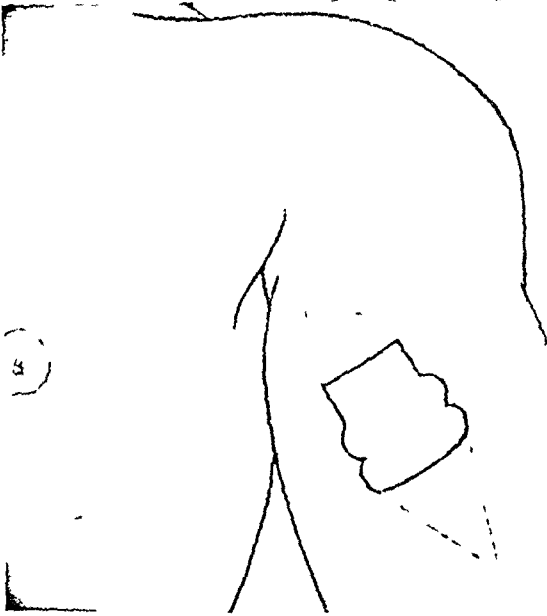


FIG 30—Forehead defect is plotted on inner side of arm

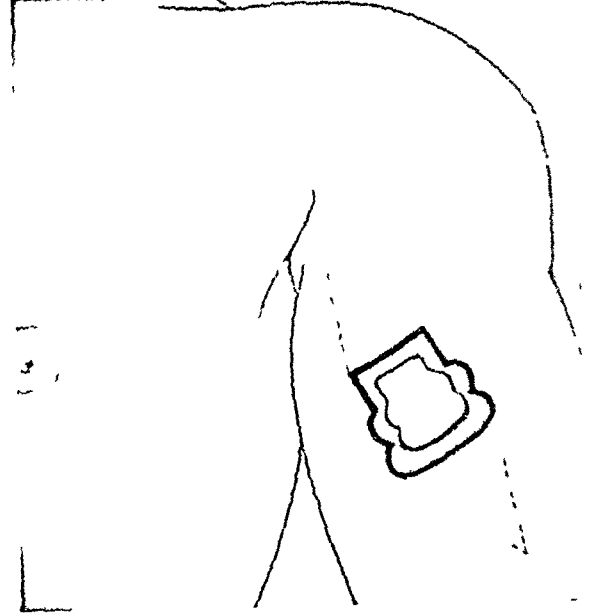


FIG 31—Note shrinkage of graft on sectioning

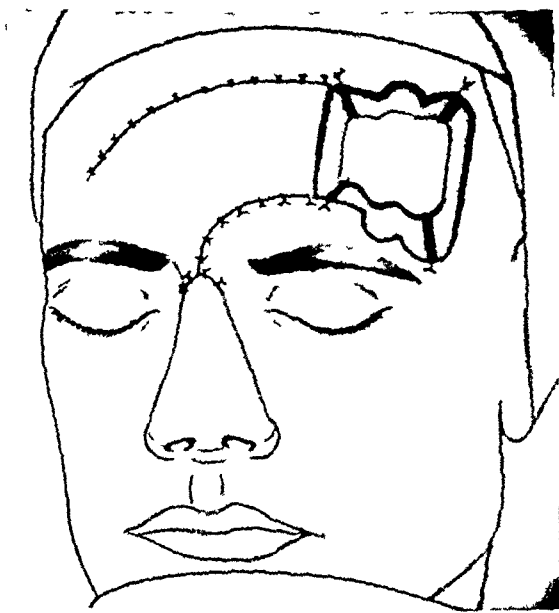


FIG 32—Wolfe graft from arm on forehead Epithelial side out



FIG 33—Graft stretched to normal and sutured



FIG 34—Nineteen days following first stage Same case as Fig 1

ness graft from the abdomen, arm, or thigh. If deemed better a small Wolfe graft, sized to fit the amount of tissue used on the nose, may be inserted in the forehead wound and the flap, when returned, sutured to it (Fig 24). In cases where further plastic work is planned shortly after the return of the flap, the forehead may be allowed to granulate in and grafted at that time.

The tube while down must be watched carefully. It should be dressed daily and any small foci of infection dealt with promptly. Sutures are removed in from one to three days. A strip of vaseline or xeroform gauze is usually all that is necessary for a protective dressing.

Third Stage—After fourteen to twenty-one days the tube is severed (Fig 27) and returned to the forehead (Figs 28 and 29). The upper

nose is then sutured to fit. Perforated nasal splints are kept in the nose for several weeks, day and night, and then only at night for a month's time.

The Wolfe graft for the forehead is best taken from the soft hairless skin of the inner surface of the arm (Fig 30), thigh, or abdomen. It is cut exactly to fit the forehead defect and dressed with xeroform gauze and sea sponge pressure, approximating twenty to thirty millimetres of mercury for five to ten days. Sutures are removed as necessary. Those showing pressure necrosis or looseness are removed at once.

Cartilage may be used to replace the septum deficiency if too pronounced a saddle nose results once repair is complete. However, it is best used after contracture is complete and swelling has disappeared.



FIG 35

RHINOPLASTY

COMMENT

The problem of total rhinoplasty then resolves itself at present into the acceptance of the Nelaton-Blair forehead flap method. The use of plaster and glue casts is advisable. The lining of the new nose is supplied by Thiersch or Wolfe grafts grown to the portion of the delayed forehead flap



FIG 36—One hundred and twenty days following first stage. Same as Fig 2

FIG 37—No cartilage has been used in either case. Figs 34 or 36

designed to cover the proximal part of the nasal deficiency. The alæ and columella are formed by infolding the distal portion of the flap. An ability to wait between stages until a blood supply sufficient for the next stage is assured is a virtue to be cultivated.

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RESTORATION OF THE SUB-SEPTAL PORTION OF THE NOSE

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DESTRUCTION of the sub-septal portion of the nose may affect its cutaneo-membranous or its cartilaginous structure. Lesions of these parts may exist by themselves or may be connected with other lesions of the lower part of the nose. The lesions in question, however, commonly constitute deformities due to tuberculosis or syphilis. The form of tuberculosis usually producing these lesions is lupus, which simultaneously affects the sub-septal region and the alæ nasæ and may more or less affect the upper lip. Syphilitic destruc-

tion is more profound and may involve the entire osteo-cartilaginous structure of the part.

Several operative procedures are available for restoration of the sub-septal region. All are based upon three essential methods, the Indian, Italian and French, which employ plastic use of tissue for replacing the deficient substance. A chronological study of the reparative methods in question shows that both the older and the modern operators prefer to use flaps taken from the immediate vicinity of the affected part, and usually from the upper lip. The method of obtaining material from parts



FIG 1—Loss of nasal septum Before operation

distant from the lesion has been abandoned, on account of the extent of operation required and the large scars thus produced, out of proportion to the area repaired.

In the Indian method, Dieffenbach employed a frontal flap, with superior pedicle, attaching its apex by an incision made in the upper lip. This method has been quite rejected. In utilizing the Italian procedure, Ch. Nelaton repaired the sub-septal area by using a flap taken from the antero-internal surface of the arm. Labat obtained skin from the thenar eminence of the left hand.

Most of the modifications have been introduced by the French method, which employs tissue taken from the near-by parts. Serre obtained a flap from that part of the upper lip corresponding to the naso-labial groove. Blandin resorted to the same region, but used the entire thickness of the lip, leaving the pedicle superior so that, after fixation of the flap to the lobule of the nose, the mucosa of the lip was turned below and outward. Lever employed the mucosa itself, which was introduced by an incision made in

SUB-SEPTAL RESTORATION

the upper border of the naso-labial groove Dupuytren, Dieffenbach and Nicoladoni employed cutaneous flaps from the upper lip which were horizontal or oblique below Szymanowski and Dieffenbach applied flaps taken from the back, or ridge, of the nose Raoult and Demons used two lip-flaps, and Payr employed two flaps taken from the naso-genian folds Lossen and Mikulicz took their flaps from the borders of the alæ nasæ in special cases

Any of these methods may be practiced, provided the defect in the sub-septal region include only its cutaneous and membranous portion With more extensive lesions, flaps taken from the soft parts themselves are insufficient, because the consequent retraction deforms the lobule of the nose For this reason, the repaired sub-septal region is supplied, in suitable cases, with more effective support, formed from bone or cartilage With this object in view,

Hildebrandt formed an osteo-plastic frontal flap, conducting it through the nasal cavity by means of an incision made in the ridge of the nose Hacker advises a bony fragment taken from the excavated border of the piriform orifice Joseph obtains an osteo-periosteal graft from the tibia, inserted into the upper lip before it is severed For the same purpose, he employs cartilage taken from one rib, or from the auricle of the ear In special cases, he even takes cartilage from the alæ nasæ, in a procedure which he calls rhinometathesis Plastic methods of this kind have also utilized the phalanges of the little finger (Leischner) or second toe, at first grafted into the palm of the left hand and used



FIG 2—After operation

later for filling the defect in the sub-septal region, after the Italian method Removal of the nail before operation is evidently necessary Attempts at homo-plastic treatment resulted in complete failure (Leischner)

Frangenheim used the lower border of the quadrangular cartilage with posterior pedicle covered, because of lesions present, with fully healed mucosa imitating the normal skin In another case, he used the vomer, which was trimmed suitably and lowered to the anterior nasal spine

In our case, presenting a total loss of the mobile part of the sub-septal region and a partial defect in the cartilaginous and bony structure of the part, we used a combined method, taking a posterior flap from the mucosa of the upper lip, to constitute two-thirds of the sub-septal region, and an anterior flap from the skin of the vestibule of the nose, to repair the remaining third of the defect In order to provide effective support for the repaired part and prevent retractile deformity of the lobule of the nose, we implanted a cartilaginous plate taken from a rib Following we give the details of the procedure

Operation was begun by instituting local anæsthesia at considerable distance from the site of operation, in order that the œdema accompanying the anæsthesia might not produce deformity at the operative site. A rather large flap was then taken from the mucosa of the upper lip, extending only to its ruddy portion, its pedicle extending in width one centimeter on each side of the little central ridge leading to the vestibule of the nose. The free apex of the flap was introduced through an incision across the naso-labial furrow. Since the flap itself was too short and would cause deformity after suturing it to the lobule of the nose we took an anterior flap, mentioned above, from the skin of the vestibule of the nose. This flap was so taken that its pedicle lay beneath the protuberance of the nasal lobule, the final position of the epidermal surface becoming external and turned below, while its raw surface lay above and interiorly, like the remainder of the posterior flap. The two flaps were united at the site of contact by a few sutures of silk.

Into the sub-septal region, thus repaired, was now introduced a cartilage fragment taken from the seventh rib. The graft must be removed without involving the entire thickness of the costal cartilage. This precaution permits avoidance of bleeding and risk of injuring the peritoneum.

In such cases as these, we always prefer cartilaginous grafts because they possess almost no blood vessels and are thus already accustomed normally to imperfect nutrition. In this way, success of the grafting is much facilitated. Again, cartilage is eminently suitable for plastic uses. It is easily shaped, may be perfectly modelled and becomes infected with greater difficulty than is the case with bone. Bony grafts, as we have found by studying our clinical material, is likely to be resorbed after a year if it is not placed in tissue resembling that of its original site, and depends upon the size of the graft more than do cartilaginous grafts.

The wound was healed, and the sutures were removed, in twelve days after operation. In the post-operative treatment, it is very important to remove the free secretion by means of inhalations and the use of a protective ointment.

Opinions of various writers differ concerning the behavior of the mucous membrane, which is exposed to immediate contact with the air and constitutes two-thirds of the sub-septal region when the latter is repaired, as in our case. Some think that the mucosa, when thus exposed to external agencies, becomes converted into skin, as observed sometimes in rectal or uterine prolapse. Rollet states that the mucosa forming the external aspect of the flap becomes gangrenous in four days after operation, sloughs off, and leaves the surface of the mucosa to heal by granulation. Others, such as Sedillot, Nelaton and Ombredanne, believe that the mucosa undergoes no process of epidermization essentially but that it remains thin and rosy and is constantly covered by exfoliating particles which are continually renewed.

In closing we may state that the mucosa, as occurring in our case, assumes the character of skin in time. Only at the outset is it covered by free secre-

tion and exfoliation, due to irritation and to the changes in environmental conditions which it encounters. We have noticed similar changes in the mucosa, accompanying prolapse of the vagina. Under abnormal conditions, the mucosa doubtless undergoes metaplasia. The influence of external agents is well known for its ability to induce metaplasia, as for example, in pigmentation of the skin, ossifying myositis, and conditions of analogous character.

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PARATHYROIDECTOMY FOR ANKYLOSING POLYARTHRITIS*

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OF THE many pathologic conditions affecting the spinal column, two have been recognized for many years one, described by Bektereff, termed "stiffness or rigidity of the spine" and the other called by P Marie "spondylose rhysomelique" These conditions have been described in literature, being respectively termed Bektereff's disease and Strumpel-Marie's disease The symptom-complex of the two conditions considered differs in that in Bektereff's disease there is to be noted a bow-shaped kyphosis of the entire spinal column, while in Marie's disease the spine is fixed and erect, usually with an accompanying involvement of the hip- or shoulder-joints In the case of the former, there is merely a stiffness and rigidity of the spine, while in the latter there is a definite ankylosis, not only of the spine, but of the big joints of the extremities On careful investigation, the difference between these conditions is a question, apparently, of degree only This was pointed out by Turner of Leningrad after having studied many preparations of bones he had acquired following the deaths of patients suffering from these conditions He was able to demonstrate conclusively that if prolonged enough the condition described by Bektereff finally ended in an ankylosis of the spine Various combinations of stiffness and partial immobility in both the spine, hip, shoulder-joints and ribs have been noted by many observers Indeed some of the cases I have observed have gone so far as to have complete involvement of all joints of the body Therefore, the difference between the two conditions is quantitative rather than qualitative Before reaching the final stage described by Marie they all pass through the stages first of interference with mobility on to complete immobility and finally ankylosis It is, therefore, suggested that in referring to these conditions a term be used to cover both, such as ankylosing polyarthritis

It appears evident to me from observations that the kyphosis spoken of by Bektereff is a distortion of the spine, due to the fact that the patient suffering from this condition is still able to walk and work, and that the spine takes this curvature due to the weight of head and shoulders If, however, the patient is incapacitated and lies in bed continuously, the spinal column becomes ankylosed in a straight or erect position In three cases under my personal observation, who were apparently suffering from Bektereff's disease with kyphosis and were put to bed and treated orthopædically under an anæsthetic, the spinal columns were straightened and plaster-of-Paris cases applied for two to three months When removed, the spines were ankylosed

* Translated from the Russian by A S Kasatchenko, M D , of Montreal, Canada
Read before the IX Congress of Physicians at Quebec, Canada

in a straight position with a similar ankylosis of the hip-joints which had also been encased in the plaster

Of these patients who have developed ankylosing polyarthritis, one is as a rule able to obtain a history of an infectional process such as scarlet fever, typhoid, spotted fever, acute suppurating osteomyelitis or gonorrhoea, which conditions have immediately preceded the subsequent affection of the spine and of the other joints. It is interesting to note that although these conditions are apparently an infection of the joint following acute inflammatory conditions, sometimes chronic, suppuration does not develop and cause localized joint abscesses but merely terminates in an ankylosis of the affected joint. Puzzling also is the explanation of why some of the patients so affected have their joints finally ankylosed while others do not have this condition occur.

Doctor Belsgorodsky in making detailed and analytical examinations of his patients suffering from ankylosing polyarthritis discovered in all of them an increase of the calcium content of the blood, while Doctor Schraer noted that ordinarily such patients had a reduced electro-excitation of the muscles and Doctor Demidovskaya stated that he had noted in many an increased viscosity of the blood. In the recent data supplied by Doctor Samarin he noted that in 26 patients, whose blood had been examined, 19 showed a lymphocytosis as high as 50 per cent, of 14 patients examined, 11 showed an increased viscosity of the blood, using the apparatus of Litchikowsky, based upon the time of 5 seconds as normal. In these cases it frequently reached 6 to 7 seconds. On the basis of 4 milliamperes electro-excitation, out of 22 patients, there were 19 who showed a reduction from 5 to 10 milliamperes. In 42 patients in which the calcium content of the serum was determined, 28 showed a definite hypercalcaemia, while 14 had a normal calcium level. Assuming between 9 and 11 milligrams of calcium as the normal, the contents of these varied from between 6 and 15 milligrams per cent, out of 29 cases in whom the potassium content was investigated, 7 cases showed it increased (from 29 to 37 milligrams per cent and in 3 cases it was lowered (from 13 to 16 milligrams per cent). In the remaining, it was normal, indicating that there was no sharp change in the level of the potassium. Finally it was noted by Nekrasoff that the inorganic phosphorus was apparently increased while the organic phosphorus was normal or but slightly increased, assuming 2.8 milligrams per cent of inorganic phosphorus to be normal, while the average percentage in these cases examined was 3.43.

Therefore, it is to be noted that there is (1) an increase of the level of calcium in the blood, (2) a decrease of electro-excitation of muscles, which findings are just the opposite of those in tetanus in which the calcium level is lowered and the electro-excitation of muscles increased. In tetanus, one notes cramps while in polyarthritis there is a restriction or tightness or stiffness on motion. If we consider tetanus as an expression of hypofunction of the epithelial bodies, then all of the above-mentioned findings in cases of ankylosing polyarthritis would incline us to infer that we are dealing with a hyperfunction of the epithelial bodies. What called my attention more par-

ticularly to the hyperfunction in these cases was the apparent deposit of excessive calcium formation at the foci of inflammation or in diseased joints, and because of the presence of which the inflamed joints pass into a stage of ankylosis after the preliminary stiffness

Correlating the work of Collip, who showed that the hormone of the parathyroid bodies increased the level of calcium in the blood, with the findings in cases of ankylosing polyarthritis, it appeared evident that my theory of hyperparathyreosis received material support and that, theoretically, this condition is instituted through the infections preceding the development of the joint conditions developing in certain persons possessing a predisposition or constitutional tendency to hyperparathyreosis

Therefore it appeared to me a logical reasoning that in order to prevent the development of ankylosis or to eliminate preliminary stiffness, it was essential to diminish the hypercalcæmia by destroying a part of the epithelial bodies which were causing this condition in the blood, which, as indicated, appears to originate in the parathyroids

The operation is, as a rule, ordinarily done under local anæsthesia, incision being made along the front edge of the right sternocleidomastoid muscle. The inferior thyroid artery is first identified and the parathyroids searched for where the inferior thyroid artery enters the thyroid body. There is, as a rule, a lower, small gland and an upper one. In order to be more certain of their removal, the capsule is incised and a portion of the right thyroid gland resected. In some instances, it is to be noted that the parathyroid is incorporated in the substances of the thyroid gland itself which is at times evidenced in the development of a parathyroid growth in the substance of the thyroid gland (Craft). The microscopical verification of the excised parathyroid bodies shows how difficult it is to recognize them and how difficult and delicate a parathyroidectomy is. We have operated on fifty-five patients. In thirty-three of these cases, Doctor Samarin made microscopical examinations of the tissue removed. In ten cases no parathyroid tissue was found, although in these examinations a complete serial section was not made. Out of the twenty-one patients in which the parathyroid bodies were found to be present, it was noted in only two instances that two parathyroid glands had been extirpated. While it must be evident how important it is to receive a microscopical criterium of the removal of these epithelial bodies, we are also most interested in the resultant chemical change in the blood. This examination should be done within two weeks after the operation but after recovery from any shock which might have been caused by the operation itself. Out of thirty investigations, twenty-seven showed that the postoperative calcium level was in some instances reduced to 1-3 milligrams per cent. Therefore it would appear that the chemical criterium was more illuminating than the microscopical. In addition also, the chemical examination of the blood confirms the fact that in some instances the epithelial bodies were not removed at operation.

The results of the above procedure have been most interesting. As already

PARATHYROIDECTOMY FOR ANKYLOSING POLYARTHRITIS

mentioned, these diseased joints go through a stage of stiffness or interference with their mobility, the patient being conscious of a feeling of distress in them and of some limitation of motion. While parathyroidectomy cannot alter the already formed ankyloses, which for their correction require mobilization, still it is advisable to precede such mobilization with parathyroidectomy in order that after manipulation there will not be a predisposition on the part of the patient again to deposit lime in the joint.

Sometimes the most striking effect resulting from this operation is that as early as twenty-six hours after parathyroidectomy this sensation of stiffness has been noted to disappear from one joint after another. If it has affected the shoulders and it is difficult for the patient to lift his arms, they are thereafter easily moved and the patient describes the joint as having become much looser. Even joints with which there was extreme difficulty in motion become progressively and sometimes completely movable. In the hip-joint where it has been impossible for the patient to cross his legs, postoperatively he does it easily. Those with the stiffened spinal columns increase in stature several centimetres because of their ability to make the columns more erect.

Samarin, in summarizing the results in forty-nine cases following parathyroidectomy found no improvement in sixteen and improvement in thirty-three cases. If one takes into consideration the fact that in ankylosing polyarthritis the patient in all probability cannot be cured and has effected only a moderate improvement on the employment of thermal baths, the results of this operation may be considered very encouraging, for it primarily destroys the hypercalcaemia, thereby stopping the process of progressive ankylosis, and this is indeed the most important principle to be effected by the operation. It seems evident, in addition, that the reduction of the hypercalcaemia in some way influences beneficially the function of the voluntary muscles, giving them greater freedom of movement. While the already formed ankyloses remain, it evidently improves the partially immobilized spine without, however, completely straightening it. It is interesting to note, in addition, that in these cases, the muscles of the back show a definite stage of acute atrophy while, on the contrary, those in the front of the body are in the stage of habitual contracture.

These patients require much additional attention after the extirpation of the parathyroids. Primarily in cases of multiple ankylosis of joints, mobilization is indicated. Orthopaedic treatment is essential to overcome the atrophy of the back muscles and to cause the resumption of the erect posture of the spine.

It is, therefore, my desire thus to place before the profession what seems to me to be the ætiologic factor in these cases of ankylosis and a procedure which not only appears to be remedial for the stiffness and consciousness of discomfort and immobility of joints but also a method of preventing further ankylosis in cases of ankylosing polyarthritis.

DIRECT AND INDIRECT INJURY TO THE RECURRENT LARYNGEAL NERVES DURING THYROIDECTOMY*

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PERHAPS one of the most common complications in operations on the thyroid gland is injury to one or both recurrent laryngeal nerves. During the last few years considerable attention has been directed to the prevention of this complication, which, it is believed, is fairly common and perhaps not infrequently unrecognized.

New and many others believe that injury to one or both recurrent laryngeal nerves occurs much more frequently than most persons believe. A careful survey would lead one to accept this assumption as just and true. Most injuries to the recurrent laryngeal nerves probably occur because of unfamiliarity of surgeons with their anatomic position, which is different from what the average textbook pictures.

Mikulicz emphasized the importance of leaving a small amount of thyroid tissue on the lateral wall of the trachea along the course of the nerve, to prevent injury to it. Before his suggestion, Billroth reported partial or complete vocal cord paralysis in 32 per cent of a series of seventy-one cases of thyroidectomy done by Wolfier. By a statistical study, Jankowski found paralysis of the cord in 14 per cent of cases of extirpation of the thyroid gland. Following the plan of Mikulicz, Roux, in 1894, was able to do thyroidectomy 100 times without objective evidence of injury to a single nerve. Later, Kocher, in a series of 900 operations of thyroidectomy, thought his injuries to nerves amounted to 7 per cent.

It seems reasonable to assume that the most common sites of injury to the recurrent nerves during thyroidectomy are at the inferior pole of the gland, along the lateral surface of the trachea, and at the cricothyroid juncture where the nerve pierces the larynx. If a small amount of glandular tissue is preserved at the inferior pole, injury to the nerve is not likely at this point. If too much of the gland is resected along the lateral surface of the trachea and at the cricothyroid juncture, and if, also, suturing is necessary to effect hemostasis, injury to the nerve is likely. It is extremely important, in cases in which general anæsthesia is used in addition to local anæsthesia, that the patient be allowed to waken after the extirpation of one lobe, in order that the operator can determine whether or not there has been injury to a nerve.

In most instances injury to one recurrent nerve, of a sort that will be permanent, gives the patient little trouble immediately after operation and the voice usually approaches normal in two or three months. If severe

* Submitted for publication June 7, 1929

LARYNGEAL NERVE INJURY

tracheitis occurs in a case with injury to a single nerve, respiratory embarrassment may be marked for two or three days

In many cases in which there has been injury to the nerve of one side, post-operative œdema of the glottis is also present and the breathing space consequently will be narrowed, the laryngoscopic picture may be similar to that of bilateral nerve injury, but one vocal cord will be seen to move on respiration and the movement will be only slightly impaired by the œdema

Occasionally symptoms of impairment of the nerve supply develop a day or two following thyroidectomy, even though objectively during and immediately following operation, the function of the larynx apparently was normal. In a few of these patients it was possible to demonstrate, by laryngoscopic examination, impairment of the function of one or both recurrent laryngeal nerves. Constant care is exercised in doing thyroidectomy to avoid injury to the recurrent laryngeal nerves and also, in this type of case, there is improvement or complete restoration of function in two or three weeks. New has held for years and has shown clinically that temporary paralysis of the vocal cords following thyroidectomy may be caused by hæmorrhage or œdema about the nerve. In this type of case the paralysis of the cords usually clears up in about two weeks. Laryngoscopic examinations are made before, immediately after and every few days following thyroidectomy in order to observe the changes in the cords. The following case is illustrative of just such injury to the nerve

Report of a Case—A man, aged thirty-three years, registered at the clinic June 11, 1928, complaining of weakness, nervousness and loss of weight. The duration of these symptoms was three months. A diagnosis of exophthalmic goiter was made. The basal metabolic rate was +46. The patient was given compound solution of iodine, ten drops three times a day for eleven days, and at the end of this time subtotal thyroidectomy was done. At operation, each lobe was found to be enlarged to about four times the normal size. Glandular tissue equivalent to about one-fourth of a normal-sized lobe was preserved on either side. The pathologist reported the tissue removed to be that of a diffuse, hypertrophic, parenchymatous thyroid gland.

A laryngoscopic examination of the vocal cords before operation showed them to move normally. Another laryngoscopic examination was made two hours following operation and this did not show evidence of impairment of the recurrent laryngeal nerves. Thirty hours after operation, the patient complained of difficult breathing. There was moderate cyanosis, graded 2. Slight exertion caused definite stridor. Laryngoscopic examination at this time showed both cords fixed in the median line with an estimated 25 per cent of breathing space remaining. The patient was placed in an oxygen tent, which relieved to some extent the respiratory embarrassment, and the cyanosis disappeared. Hot, moist dressings were constantly applied to the wound. At the end of twelve hours, during which time frequent examinations of the vocal cords were made, there was slight movement of both cords with an increase in breathing space estimated at 40 per cent. Gradual improvement continued. The remainder of the patient's convalescence was without incident, and on the seventh post-operative day he was dismissed from hospital. Examination at this time showed a breathing space of from 50 to 75 per cent. July 2, ten days following operation, both vocal cords moved normally and there was no difficulty in breathing.

Comment—This case is an example of indirect nerve injury in thyroid-

ectomy and was caused, I believe, by œdema of the nerves or of the tissues in close proximity to the nerves, or by slight hæmorrhage exerting pressure on them

In two or three other cases in which patients who have undergone thyroidectomy signs like those mentioned have appeared. It was necessary in one case to make a tracheotomy, the opening of which was allowed to close, when, in three weeks, the cords moved normally. There is much evidence to indicate that the type of injury here discussed is not caused by direct injury to the nerves in which degeneration takes place. The observations of Judd, New and Mann were perhaps the most convincing proof of this. They showed by animal experiments that complete and permanent paralysis of the vocal cords followed if the nerve were ligated and the ligature not removed. The same result followed when the nerve was severed and prolonged but not permanent nervous impairment ensued if the nerve was stretched by an instrument or was ligated and the ligature soon was removed.

SUMMARY

Some patients who do not show impairment of the recurrent nerves at the completion of thyroidectomy may suffer from temporary impairment of the nerves through indirect injury. Tracheotomy may be necessary in some of these cases.

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IMMEDIATE AND EVENTUAL FEATURES OF HEALING IN AMPUTATED BONES

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THE surgical problem of a limb amputation ideally ends with healing of the operative wound. But even when this fortunate event takes place there is still an orthopedic problem to follow, and all too frequently surgical interference is again necessary.

Enjoying the opportunity afforded by the unique material in the Hamann Museum of this University it appears timely that a comprehensive survey be made of the after-results and complications so far as these reveal themselves in the amputation stumps. The five following general subdivisions at once appear:

- 1 Gross and detailed features in the healing of bone stumps and the changes in texture of the portion of the limb skeleton remaining
- 2 Changes in muscle and weight of the stump itself
- 3 The character of, and complications occurring in, the stumps of severed nerves
- 4 Clinical developments directly determined by the condition of the stump in the after life of the patient
- 5 The lessons to be learned from experimental amputations

These several subdivisions are not clearly demarcated one from another and it is necessary to include them all for a complete understanding of the problems involved in, and consequent upon, amputation. It is my plan to set forth the results of this study in successive communications. Acknowledgment is due to Western Reserve University for the privilege of investigating the material and for the technical facilities freely put at my disposal for this purpose. I also desire to express my indebtedness to Dr. Wingate Todd for guidance and direction in planning the work and for help in interpretation of my findings. In the experimental work, later to be discussed, I am under a debt of obligation to Dr. H. H. Donaldson of the Wistar Institute, Philadelphia, and especially to Dr. Harold Colson of Flagstaff, Arizona.

In this first communication I propose to discuss the features of healing in the bone stump and the changes later seen in texture of the remaining portion of the amputated bone. Among the 1500 human skeletons at my disposal I found more than forty amputations of the limbs. Six of these I have dissected completely and in all forty I have studied the bony skeleton. Presentation of the findings does not require a description of all

examples It is better to confine our attention to the features illustrated by particular specimens at successive stages of repair and in later phases of the life history We shall proceed, therefore, immediately to the discussion of representative examples, paying particular attention at the moment to those features readily noticeable by the naked eye, but also confirming and extending our observations by rontgenographic findings

THE PHENOMENA OF HEALING

The most recent amputation to which we have access is the right tibia and fibula of No 262—male, white, about forty years of age Death was registered as from tuberculosis The patient obviously sank quickly after operation and soon died and the rough-cut edges of the stumps show indications in their irregularity of haste at operation So rough and jagged indeed are the edges that one might suspect the specimen to be the result of a post-mortem amputation were it not for the erosion of the bone so



FIG 1—Amputation right tibia fibula WRU 262 Male, white, about forty years
A—Recent amputation just below tuberosity Cut edges of bones rough fissure in subcutaneous
surface tibia, no callus B—Röntgenogram of A Fissure of tibia identifies lower edge as ventral
margin Entire circumference shows vascular erosion

evident in the rontgenogram (Fig 1) There is not the slightest indication of surface erosion or of callus formation Bast, Sullivan and Geist¹ found new bone as slender microscopic spicules as early as the fourth day and absorption of cortical bone on the fifth day The rontgenographic evidence on this amputation very definitely indicates the earliest stage of reaction Consequently we may assume that not more than five or six days have elapsed since amputation was performed

Another very recent amputation in this collection is that of the right tibia and fibula in No 864—male, Negro, forty-eight years of age Death occurred from lobar pneumonia which we may consider was post-operative in origin The operative wound was still unhealed in the cadaver The amputation severed the bones in their middle third The cut surfaces were not rounded off at operation they have sharp edges and the surface, showing plainly the saw marks, is polished as though by a blunt-bladed instrument There is definitely increased vascularity with accompanying erosion on both bones, especially on the medial and posterior surfaces of the tibia Indeed on the lateral aspect of the fibula this erosion begins to delimit the line of flake-like sequestrum formation which would ultimately have involved the entire cut surface Internal callus is evident on both bones but as yet there is no external or surface callus The features

HEALING IN AMPUTATED BONES

just described would easily escape notice for they are not striking. The rontgenogram, however, clearly shows the pre-repair erosion of both bones adjacent to their cut surfaces (Fig 2)

The specimen recalls the femur of No 156 in the article by Todd and Ile.² Now internal callus was observed by Bast, Sullivan and Geist¹ on the fourth day and erosion on the fifth after a saw cut was made on the tibia of rabbits. Erosion rapidly increased in degree during the immediately succeeding days. Actual flake-

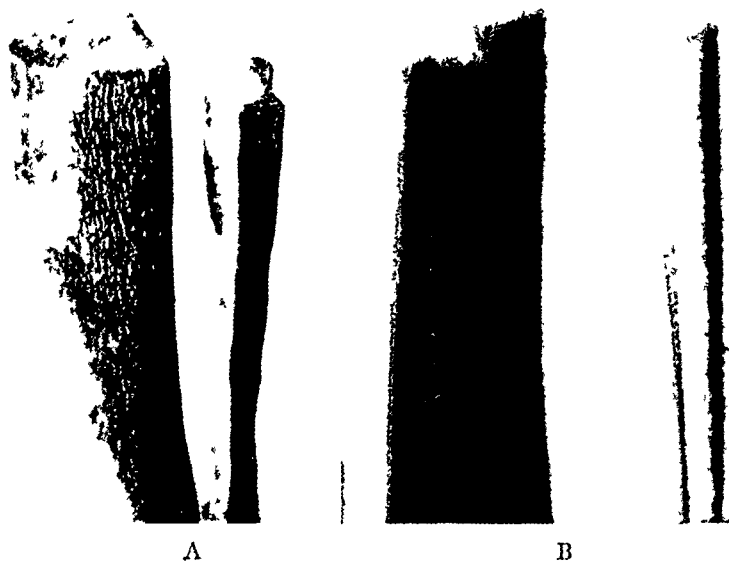
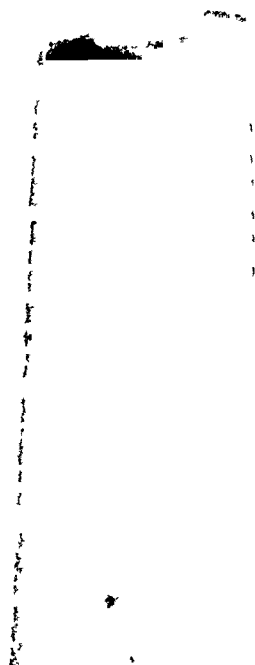


FIG. 2—Amputation right tibia, fibula. W R U 864 Male, Negro, forty eight years. A—Recent amputation middle of shaft. Cut surfaces show saw marks, some increased vascularity, slight internal callus. B—Rontgenogram of A. Well marked vascular erosion of entire circumference in cortex.

like sequestria were noted by Todd³ within three weeks of operative trauma. We may conclude that this specimen No 864, is from an individual who lived



A



B

FIG. 3—Amputation left femur. W R U 319 Male, white, fifty years. A—Recent amputation middle shaft. Vascular erosion of entire circumference with rounding of margin slight internal callus, some external callus posteriorly. B—Rontgenogram of A. Well marked vascular erosion, osteoporosis extends upward along shaft.

not less than seven days and certainly not twenty-one days after the amputation. The stage of cancellous endosteal callus found in this specimen corresponds with that reached by the rabbits of Bast, Sullivan and Geist,¹ between ten and twelve days after trauma. We may then cite our second case as illustrative of the features to be found in a human bone about eleven days after amputation.

The next stage in repair of an amputation stump is found in No 319—male, white, fifty years of age, ill with tuberculosis of the lungs.

This specimen is a left femur cut through the middle of the shaft. There is still evidence of recent saw cut in fragmentary remnants of polished flat surface, but for the most part, new vascularity has eroded the entire end of the stump and rounded off its sharp margins. There is internal callus, cancellous in texture, in the most dependant posterior portion of the bone and on the

dorsal aspect there is external callus intimately united with the eroded bone. The roentgenogram (Fig 3) shows little increase of erosion over No 864. We may confidently assign this specimen to some thirteen days after surgical interference since the erosion, though well started, is by no means so advanced as found by Todd in the specimen E16, twenty-one days after the onset of osteomyelitis.² It is in this specimen that we observe the earliest sign of atrophy, namely clarification of architecture in the upper femur. It is altogether too delicate to reproduce in the roentgenogram and in this specimen it may not represent the permanent atrophy which we shall discuss further on. The cortical bone of the shaft is osteoporotic and this appears as a "moth-eaten" texture in the roentgenogram.

Right femur No 1585, amputated through the middle of the shaft, was obtained from a male Negro, dying of tuberculosis at the registered age of thirty-one years.

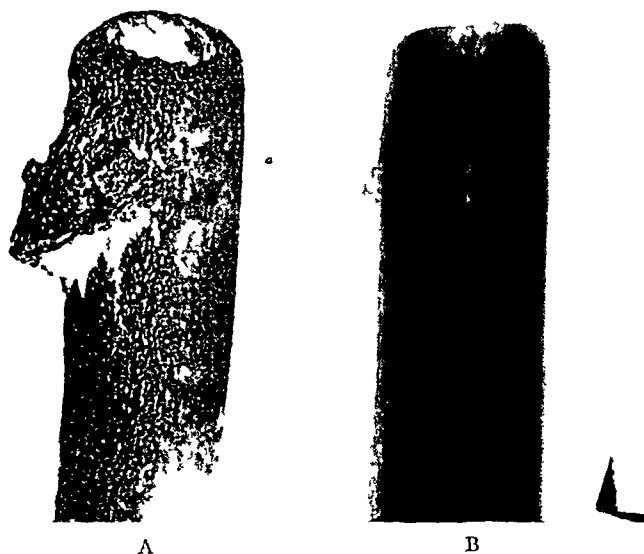


FIG 4—Amputation right femur WRU 1585 Male Negro, twenty six years. A—Recent amputation middle shaft. Cut surface shows much vascular erosion and rounding, no internal callus, external callus forming osteophyte. B—Roentgenogram of A. Well marked erosion of stump with osteoporosis extending up shaft, external callus developing into osteophyte.

There is some reason to believe that this individual was actually about twenty-six years of age. The wound was healed. There was considerable muscular atrophy but the stump was not adherent to the skin. There was enlargement of right inguinal glands following an ulcer of the groin. Erosion of the stump with its consequent rounding of the margin is very clearly seen both on the specimen and on the roentgenogram (Fig 4). No internal callus is to be found and critical examination of the specimen makes it certain that the absence of endosteal callus is genuine and not due to faulty preparation. It is the more remarkable that there should

be no callus in the marrow cavity because there is a large mass of external callus on the medial and posterior surfaces firmly united to the underlying bone and already largely converted into a sclerosed cancellous excrescence.

We shall have to draw attention to this absence or minimal development of endosteal callus in further specimens reported in this essay, at the moment it is sufficient to record the fact. The lava-like external callus together with the marked erosion identify this specimen as at approximately the stage of fracture as No 388 in the report by Todd and Iler.² On the basis of other features characteristic of fracture, but absent from amputations, these authors assign No 388 to some seventeen days after injury. We may, therefore, consider our specimen No 1585 also to illustrate the condition present in an amputated stump about seventeen days after surgical interference.

It should be noted that the appearance of external callus in this specimen is quite erratic. But Todd and Iler have already emphasized the

HEALING IN AMPUTATED BONES

eriatric exhibition of bone repair We see the same character in this amputated stump It is undoubtedly due to this fact that isolated osteophytic growths are sometimes found in clinical cases

In the last example reference was made to upward extension of osteoporosis along the shaft with clearing of texture in the upper part of the bone Both features are much better marked in No 1585 and their presence suggests that a rapid rarefaction of bone is occurring

No 952 is the amputated right femur of a male, white, forty years of age The patient hanged himself after discharge from hospital There was no marked atrophy of the stump though it was bluntly conical The wound was healed

The amputated surface and adjacent shaft show vascular erosion of considerably closer texture than in the preceding examples This is plainly due to a healing or condensation of the osteoporosis following the surgical trauma The margins are rounded There is no internal callus and we have reason to assume that such internal callus as there ever was has by this stage been absorbed Remnants of external callus exist as irregularities of the cortical surface The face of the stump shows an attempt at capping of the medullary cavity by a thin condensed extension of the stump margin brought about apparently through the formation of a kind of definitive callus

The roentgenogram (Fig 5) shows a healed vascularity of closer texture than in previous roentgenograms It also demonstrates osteoporosis of the shaft and atrophic texture of the upper end of the femur The appearance of the bone strongly suggests a lapse of time after amputation comparable to healed fracture No 453 in Todd and Iler's² communication The only statement these authors would hazard is that "not many months" had elapsed And with this we must also be content though we should prefer the phrase "not many weeks"

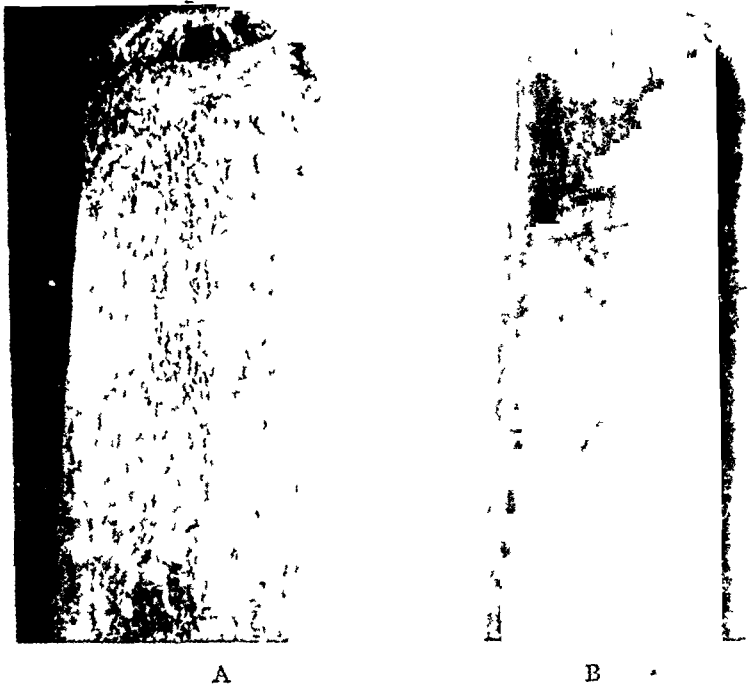


FIG 5—Amputation right femur WRU 952 Male, white, forty years A—Amputation through middle of shaft, not many weeks previously Texture of stump is condensed and characteristic of a healed bone Stump rounded Very inadequate attempt to form cap of bone closing marrow cavity B—Röntgenogram of A The erosion of the bone end is obscured by healing or condensation, attempt at capping of medullary canal too feeble to be apparent

THE ULTIMATE FEATURES

The next stage in healing is illustrated by No 1519—the left femur of a male, white, seventy-one years of age, amputated in the lower third The patient was stated to suffer from chronic interstitial nephritis and senile dementia The bone shows typical atrophic textures of senility and the cadaver itself showed a conical but not a pointed stump There is no doubt that amputation had occurred many years previously

An attempt to close the marrow cavity has resulted in the formation of a thin condensed cap of fenestrated bone with no narrowing or filling in of the marrow cavity



FIG 6—Amputation left femur WRU 1519 Male white, seventy one years A—Amputation of long standing through lower shaft General osteoporosis of shaft quiescent in type with rounding of stump and fenestrated cap of bone closing medullary cavity B—Röntgenogram of A General osteoporosis without moth eaten surface such as appears in more recent examples Dark shadow of condensed and quiescent bone in cap Irregularity due to dorsal osteophytes

escent The marrow cavity is closed by a condensed thin, but complete, cap of bone There is but the slightest osteophytic development (Fig 7) The röntgenogram corresponds with the above findings Indeed this may be considered as a perfect technical result and illustrates for us the ideal attainable termination in stump formation There is no evidence that with the passage of years this bone has become progressively atrophic, a consideration sufficiently significant from the point of view of treatment

The last of the series we desire to present is No 1332, an old amputation through the middle of the shaft of the left femur in a male, white, about forty-two years of age The cadaver showed an excellent stump except for an osteophyte projecting into the soft tissues on the medial aspect of the thigh Death occurred from suicide by hanging

and but slight dorsal osteophytic formation There is typical rounding and atrophic texture of the stump such as we find in all old amputations (Fig 6)

The röntgenogram shows osteoporosis throughout the shaft, it is true, but this is quite inactive It is uniform and free from the moth-eaten texture of the shaft surface such as we saw in the foregoing specimens The dark shadow of condensed bone in the cap is characteristic of a long-healed and quiescent stump

No 1217 is the right femur of a male, white, fifty-nine years of age, dying from cerebrospinal syphilis according to the clinical diagnosis The amputation again is of long standing and the entire bone is osteoporotic and quiescent

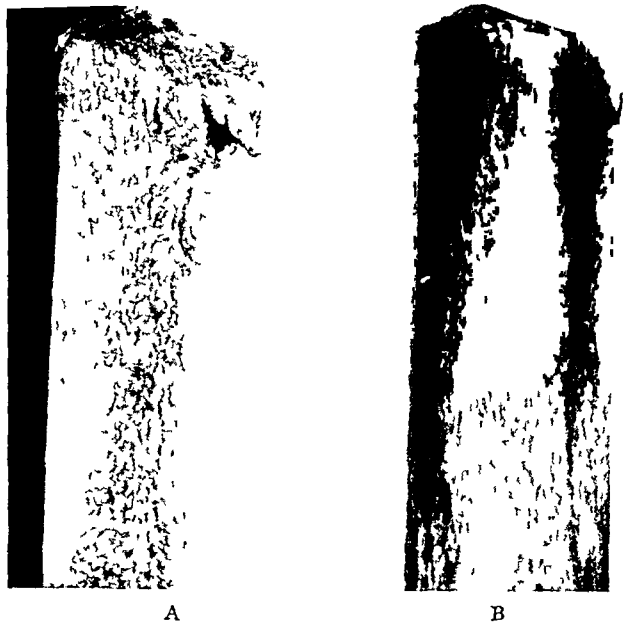


FIG 7—Amputation right femur WRU 1217 Male white fifty nine years A—Amputation of long standing through upper shaft Ideal technical result Quiescent osteoporotic shaft Complete condensed cap Negligible osteophytes B—Röntgenogram of A Osteoporosis without moth eaten surface Dense shadow of cap

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The femur, apart from the osteophyte (Fig 8), shows an excellent result. The stump is rounded, the marrow cavity practically closed by a condensed thin cap of bone. The shaft is osteoporotic indeed, but plainly quiescent. These conclusions are confirmed by the rontgenogram.

As a final problem we may ask ourselves to what good purpose can the tendency of all stumps to form osteophytes be put.

This is well illustrated in our Fig 9, the amputated right tibia and fibula of No 1291, male Negro, forty-two years of age, in whom death occurred from tuberculosis of the lungs. The amputation is of long standing. The osteoporotic shafts are quite quiescent, the medullary caps complete and the osteophyte unites the two bones. Our rontgenogram illustrates the perfect technical

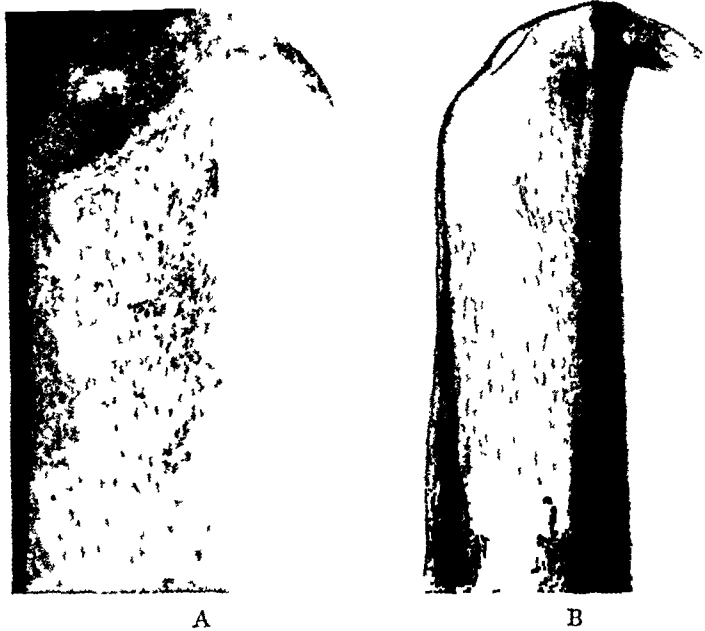


FIG 8—Amputation left femur. W R U 1332. Male, white, about forty-two years. A—Amputation through middle of shaft. Rounded stump. Quiescent osteoporotic shaft. Practically capped medullary cavity. Osteophyte. B—Röntgenogram of A. Confirms the above mentioned features.

result and shows specially well the condensed bone of the medullary cap.

Clinically one hopes to produce a fusion of the free extremities of tibia

and fibula in order to attain a firmer stump for the fitting of an artificial limb. If this result is obtained there is much less pain and discomfort to the patient. Hence the osteophyte, which is a distinct detriment in a femoral stump, becomes of material service in amputations of the leg below the knee.

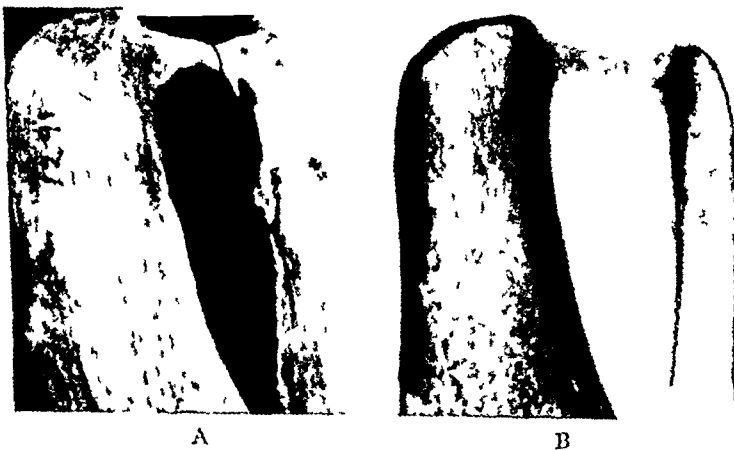


FIG 9—Amputation right tibia, fibula. W R U 1291. Male Negro, forty-two years. A—Amputation through upper leg. Rounded stumps. Quiescent osteoporotic shafts. Medullary cavities closed. Osteophyte uniting free ends of bones. B—Röntgenogram of A. Note particularly the condensed caps closing the medullary cavities.

ASSEMBLED RESULTS OF THE STUDY

1 In the foregoing description we have traced the successive stages of healing of bone in amputation stumps and noted the final results obtained in the bones through which the amputation has been performed.

2 We have found the same successive stages in bone healing which are characteristic of repair in fractures. These are, in order, vascular erosion in bone end and adjacent shaft, consequent molecular disintegration of bone adjoining the site of amputation, rounding of bony stump itself, quiescence in osteoporotic shaft, closure of medullary cavity by a cap of bone which rapidly becomes condensed, restrained production or absence of osteophytes.

3 We have been able to trace, in general terms, the time element in such phenomena and find that it accords well with the time of appearance of the corresponding phenomena in healing fractures.

4 The original erosion of the amputated end is already well advanced within five or six days of the surgical trauma, even before the marks of the saw cut are obliterated from the bone. Flake-like sequestra undoubtedly occur and probably separate in less than three weeks. These are usually absorbed but may be exfoliated if the wound suppurates. Endosteal callus of small amount has appeared within eleven days. This is shortly followed by periosteal callus which becomes condensed into a sclerosed cancellous texture within seventeen days. Later, the texture of the periosteal callus takes on a more compact appearance. In amputation stumps the production of callus is much more restrained than in fractures. Following upon these phenomena is the formation of a cap of bone closing the medullary cavity. Frequently the cap is imperfect owing to the low activity in callus production. It is not possible to define the precise origin of the cap more than to state that it is certainly developed from endosteal and definitive callus. The latter term is used, as in the description of fractures, to indicate callus arising from the severed surface itself. Lastly, osteophytes may develop. These are usually unwelcome complications of a bony stump but may be put to service in amputations of the leg if they bring about fusion of the free ends of the tibia and fibula to produce a firmer stump.

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RELATIONS OF HISTOLOGICAL STRUCTURE AND CLINICAL GROUPING TO THE PROGNOSIS OF CARCINOMATA OF THE BREAST AND UTERINE CERVIX

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IN RECENT years numerous reports have appeared in the medical literature dealing with investigations into the correlations existing between the histological structure and prognosis of malignant tumors. As a detailed description and critical consideration of the work done by others on this subject would surpass considerably the scope of this paper, our own studies only are presented in this communication.

The most reliable information in regard to the prognosis of a malignant tumor is at present obtained by an evaluation of the histological structure and a consideration of the clinical extent. These two factors have been taken into account in the work presented in this paper.

The Histological Malignancy—For the determination of the histological malignancy twenty factors characterizing the degree of differentiation and anaplasia of the tumor parenchyma and the antiplastic condition of the stroma were evaluated according to the method elaborated by one of us (Hueper). The list of these factors composing the "histological malignogram" (Hueper) and showing the numerical values given is as follows:

I <i>Special cellular and structural characteristics of carcinoma</i>			Valued 5-20
1	Special cell type of carcinoma	valued	1-4
2	Nucleo-cytoplasmic coefficient	"	1-4
3	Number of "pencil-cells"	"	1-4
4	Infiltrative growth of carcinoma	"	1-4
5	General type of carcinoma (parenchyma - stroma relation)	"	1-4
II <i>Characteristics of cytoplasm</i>			" 5-20
6	Irregularity in size of cells	'	1-4
7	Irregularity in shape of cells	'	1-4
8	Distinctness in outline of cells	'	1-4
9	Chromatism of cytoplasm	'	1-4
10	Functional activity of cells	'	1-4
III <i>Characteristics of nuclei</i>			" 6-24
11	Irregularity in size of nuclei	'	1-4
12	Irregularity in shape of nuclei	'	1-4
13	Chromatism of nuclei	'	1-4
14	Hyperchromatism of nuclei	'	1-4
15	Number of mitoses and pro-phases	'	1-4
16	Irregularity of mitoses	'	1-4

IV *Characteristics of stroma*

Valued 4-16

17	Character of stroma	Valued	1-4
18	Vascularity of stroma	"	1-4
19	Type of cellular infiltration	"	1-4
20	Amount of cellular infiltration	"	1-4

The numerical values obtained by this method are added and the sum resulting is called "histological malignancy-index" (Hueper) which represents the numerical expression of the potential malignancy of a given tumor as evidenced by its histological structure. The numerical range of the "histological malignancy-index" is between 20-80. The evaluations show that the malignancy increases with an increase in the value of the malignancy-index. For a detailed description of the technic employed reference is made to previously published papers.

The Determination of the Clinical Extent of the Growth—The clinical extent, the second factor, which has an important effect upon the prognosis of malignant tumors is represented in the clinical grouping of the carcinomata of the uterine cervix and of the breast as elaborated by one of us (Schmitz). Its estimation is based on physical findings. The carcinomas are divided into primary and secondary or recurrent. The factors which determine the clinical grading of the primary carcinomas of the uterine cervix are

Group P₁ signifies a cancer growth clearly localized within the cervix. It should be about 1 cm. in diameter. The size is determined by palpation and inspection. The genital organs are movable within normal habits.

Group P₂ indicates a growth which has extended to the periphery of the cervix in a longitudinal or transverse direction. The uterus has an impeded movability due to a doughlike consistency and decreased elasticity of the paracervical tissues.

Group P₃ means that either one or both parametria or the regional lymph nodes have been invaded, a fact which is elicited by rectal examination. The tumor mass is movable though elasticity of the tissues is lost.

Group P₄ includes the carcinomata with absolute fixation.

The primary carcinomas of the breast are classified according to similar considerations.

Group P₁ represents a clearly localized, freely movable growth which is not adherent to skin or pectoral fascia and which has not produced any metastases in the regional lymph nodes as evidenced by preoperative palpation and corroborated by post-operative histological examination.

Group P₂ signifies a single node which is still freely movable but which has produced metastases either in the breast or lower axillary lymph nodes and primary multiple tumors as observed after chronic cystic mastitis.

Group P₃ includes those tumors which have become adherent to the skin or fascia or both. There may be multiplicity in the breast and metastases in the lower and upper axillary lymph nodes. The primary and metastatic tumors are movable, though movability is impeded.

Group P₄ means that the tumor has either permeated the entire skin with

CARCINOMATA OF BREAST AND UTERINE CERVIX

ulceration, or has become fixed to the chestwall, or has produced fixed metastases in the upper axillary lymph nodes, or has invaded the supraclavicular lymph nodes, or caused multiple invasions of the skin. The other breast may be also involved. Metastases may have been produced in distant organs. The primary and metastatic growths are firmly fixed to the skin or chestwall or axillary structures.

The characteristics of the groups in the recurrent carcinomas are: Group R1 contains the local but freely movable, clearly localized recurrence, Group R2 the regional, freely movable recurrence, Group R3 the local and regional movable recurrence, and Group R4 the local or regional recurrence with fixation or secondary invasion in distant organs (supraclavicular lymph node, bone, etc.).

The clinical grouping has a threefold purpose. It indicates those cases which invariably have a poor prognosis (Group 4). It furnishes furthermore the correct indications for treatment and is an aid in establishing exact statistics to determine the therapeutic efficacy of either operation or radiation. The following table comprises the cases of primary carcinomas of the cervix and breast admitted and treated up to the end of 1924.

Five Year Good End-Results in Primary Carcinomata

Group	Number	CERVIX		Number	BREAST	
		Well	Per Cent		Well	Per Cent
P 1	23	18	78.27	13	9	69.23
P 2	48	20	41.68	29	15	51.72
P 3	161	20	12.42	34	4	11.77
P 4	100	0	0	31	1	3.23
Total	332	58	17.50	107	29	27.10

Operability <i>i.e.</i> Groups 1 and 2 is 21.09 per cent. Relative curability in 71 operable cases was 38, or 53.52 per cent with the use of radium and X-rays.	Operability <i>i.e.</i> , Groups 1 and 2 is 39.25 per cent. Relative curability in 42 operable cases was 24, or 50.72 per cent with operation and post-operative X-ray treatment.
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RESULTS OF STUDY

Malignancy indices were determined from 225 cases of carcinoma of the uterine cervix and 136 cases of carcinoma of the breast. The patients entered Mercy Hospital in the years 1922-1927.

Malignancy Index and End-Results—The prognostic value of the histological malignancy index was tested against the end-results obtained. The malignancy indices were first determined and they then were entered in the clinical histories. Thus the work of the pathologist could not be influenced by the end-results obtained. The following classification of the end-results was made. Clinical End-result 1 means that the patient was free from symptoms and showed anatomical healing three years after termination of the treatment. End-result 2 indicates death during the third year. End-result 3 means death during the second year, and End-result 4 death during the first year after treatment. Cases of Clinical Group 4 are eliminated from the following compilation as they almost always have a poor prognosis regard-

less of the histological malignancy index and the treatment used. The end-results were known in 100 cases of cervical carcinoma and 71 cases of carcinoma of the breast.

To test the histological malignancy index against the good end-results the values were divided into four even parts. The average malignancy index value of cervix carcinomas is 55.76 and for breast carcinomas 56.04, hence 56 was taken as the average value. Each malignancy index group has a range of 12 points, that is, Group 1 from 32 to 44, Group 2 from 45 to 56, Group 3 from 57 to 68, and Group 4 from 69 to 80.

	Breast Cervix		Breast Cervix		Breast Cervix		Breast Cervix	
Malignancy index	32-44		45-56		57-68		69-80	
Number of cases	2	5	24	29	24	26	3	2
Number of End-result 1	2	4	18	17	12	7	0	0
Percentage of End-result 1	100	80	75	58.62	50.0	26.92	0	0

Three cases of Clinical Group 4 were excluded from the compilation of the cervical carcinomas.

The practical significance of the histological malignancy index is strikingly demonstrated by the agreement of the figures given above. The general average malignancy index of the 136 breast carcinomas is 56.04 and that of the 225 carcinomas of the uterine cervix is 55.76. The average malignancy index of 32 breast carcinomas with end-result 1 is 53.20 (range 40-64) and of 31 cervical carcinomas is 52.45 (range 40-64). Eleven of these 32 breast cancers or 35.5 per cent have a malignancy index above the general average index of 56.04 and 8 of the 31 cervical cancers or 25.81 per cent are above the general average of cervical carcinomas of 55.76. The average malignancy index of 22 breast carcinomas with an end-result 2-4 is 59.88, while that of 36 cases of cervical cancers with end-result 2-4 is 59.39. Sixteen of these 22 cases of breast cancer or 72.82 per cent have a malignancy index above the general average malignancy index, while 22 cases of 61.1 per cent of the 36 cervical carcinomas have a malignancy index above this general average malignancy index.

Average Malignancy Index

	Cervix	Breast
End-result 1	52.45	54.48
End-result 2	53.00	59.11
End-result 3	60.00	58.70
End-result 4	61.00	61.35

This table shows that the malignancy index has a tendency to be higher in cases which take a rapid course than in those with a slow course.

Distribution of the Carcinomas in the Malignancy Groups

	Cervix		Breast	
Group 1 (32-44)	16.82 per cent	(38 cases)	2.94 per cent	(4 cases)
Group 2 (45-56)	42.92 per cent	(98 cases)	36.76 per cent	(50 cases)
Group 3 (57-68)	36.72 per cent	(83 cases)	56.62 per cent	(77 cases)
Group 4 (69-80)	3.54 per cent	(8 cases)	3.68 per cent	(5 cases)

CARCINOMATA OF BREAST AND UTERINE CERVIX

It is evident from this compilation that the carcinomas of the breast have on the average a somewhat higher histological malignancy than those of the uterine cervix, as the carcinomas of the breast are less frequent than those of the cervix in the first two malignancy groups

Special Cell Type and Malignancy Index

Cell Type	Cervix	Breast
Cell type 1	45.67 (range 38-54)	40.5 (range 40-41)
Number of cases	9	2
Cell type 2	48.62 (range 32-68)	51.75 (range 44-62)
Number of cases	61	16
Cell type 3	54.65 (range 37-70)	54.70 (range 47-70)
Number of cases	106	43
Cell type 4	60.76 (range 41-75)	56.41 (range 42-72)
Number of cases	49	91

In the compilation of the breast carcinomas 16 malignancy indices of tumors with changed cell type in recurrences were included

This compilation permits the conclusions that the special cell type or the degree of differentiation runs to a certain extent parallel with the degree of histological malignancy in the respective types. But it is also apparent that the evaluation of a carcinoma by the method of the malignancy index gives far more reliable results than the grading of carcinomas on the basis of cell type or degree of differentiation. The differences between the average malignancy indices of the different cell types are not marked enough to indicate definite differences in malignancy and prognosis for most of the groups.

GENERAL TYPE OF CARCINOMA AND MALIGNANCY INDEX

The relation existing between the general type, the malignancy index and the prognosis of a carcinoma was studied to ascertain the fact whether highly cellular tumors are more malignant than oligo-cellular (zellarm). For this purpose the average malignancy indices of the carcinomas of the general type 4 were compared with those of the general type 1.

Average Malignancy Index

	Cervix	Breast
General type 4	54.11	57.44
Number of cases	120 (53.33% of total number)	65 (47.06% of total number)
General type 1	52.30	55.16
Number of cases	20 (8.89% of total number)	19 (13.97% of total number)

One may state that, in general, cellular or medullary growths are more likely to have a loose, vascular stroma with a more or less marked round cellular infiltration, while the rather oligo-cellular or fibrous or scirrhous cancers show usually a fibrous or hyalinized stroma with few vessels and scant round cell infiltration. Deviations from this rule occur but were not taken into consideration.

The numerical difference between cancers of general type 4 and general type 1 is three points if all other factors are equal. As is apparent from the table the actual difference is less than anticipated (1.81 and 2.28). More-

over one has to consider that the antiblastic status of the stroma of medullary cancers is usually less marked than that of scirrhus ones. This statement is substantiated by the following figures. In medullary cancers of the breast the stroma contributed on the average 12.00 points to the malignancy index. In medullary cancers of the cervix the stroma added 11.28 points, while in scirrhus carcinomas of these organs only 9.67 points (breast) and 9.9 points (cervix) respectively were contributed to the malignancy index by the stroma. The differences are 2.33 points for the breast and 1.38 points for the cervix. If these observations are taken into account it becomes evident that the parenchyma of scirrhus cancers is more malignant on the average than that of medullary tumors. The blastic qualities of the parenchyma of a scirrhus cancer of the breast surpass by 3.05 points (0.72 plus 2.53) and those of the cervix by 2.58 points (1.81 plus 1.39) those of the medullary tumors of the respective organs.

CONCLUSIONS

1. A description of the determination of the histological malignancy index and the classification of the clinical groups based on the extent of the carcinoma has been given.

2. The histological malignancy indices were determined in 225 cases of carcinomata of the uterine cervix and 136 cases of carcinomata of the breast. The end-results were known in 100 cases of cervical and 71 cases of mammary cancers.

3. The prognostic value of the histological malignancy index was tested against the end-results obtained. The result is that the malignancy increases with an increase in the value of the malignancy-index. In Malignancy Group 1 the good end-results were 100 per cent in breast carcinomata and 80 per cent in cervix carcinomata. In Malignancy Group 2 the good end-results were 75 per cent in breast cancers and 58.6 per cent in cervix cancers. In Malignancy Group 3 the good end-results were 50.0 and 26.9 per cent respectively, while in Malignancy Group 4 good end-results were not obtained in a single instance.

4. The clinical grouping gave relatively similar values. The five-year good end-results in Clinical Group 1 were 69.23 per cent in breast cancers and 78.27 per cent in cervical cancers. In Clinical Group 2 they were 51.72 and 31.68 per cent respectively, in Clinical Group 3 they were 11.77 and 12.42 per cent respectively, and in Clinical Group 4 they were 3.23 per cent and 0 respectively.

5. The study of the degree of histological malignancy and the extent of the growth give valuable data in the prognosis and treatment of carcinomata of the breast and uterine cervix.

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RADIATION IN THE TREATMENT OF RECTAL CANCER

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RECTAL cancer is a relatively common disease. It occurs more frequently in males than in females, it attacks the young as well as the aged, many cases being encountered in young adults. Despite its relatively common occurrence, rectal cancer is seldom diagnosed early, a fact which increases the difficulty of successful treatment.

The most effectual methods of treatment for early cases are (1) Radiation therapy (2) The combined use of radium and surgery. At Memorial Hospital we prefer to use radiation therapy as the principal factor of treatment of rectal cancer. We supplement this treatment with surgery in those cases in which surgical interference offers an additional advantage. Dosage and technic of radiation therapy, and the type of operation performed are governed by the aspects of the given case.

The following variable factors should be carefully considered before treatment is outlined: (1) Ability of the patient to withstand appropriate treatment, (2) location and accessibility of the cancer, (3) size of the primary tumor, together with the degree of infiltration and dissemination, (4) grade of malignancy of the tumor, (5) degree of radiosensitivity of the cancer tissue.

The wide variations of these factors indicate that more gratifying results will be obtained when treatment of carcinoma of the rectum is governed by the above clinical and pathological aspects rather than when a routine method of procedure is adopted. Experience has proven that because of these wide variations appropriate treatment for a given case may vary from the most radical form of rectal surgery to an application of external radiation of sufficient intensity to bring about the desired result.

The first successful surgical operation occurred in 1826, when Lisfranc extirpated a cancerous rectum. Until Janeway's work, methods other than surgical were of little importance. His preliminary report in 1920 demonstrated that applications of radium were valuable in the treatment of rectal cancer. Since that time there has been a gradual improvement in radiation therapy. The advancement both in surgical and irradiation technic renders the following four procedures most effectual for eradication of this disease: (1) Application of physical agents, namely—radium and high voltage Rontgen rays, (2) combined application of physical agents and surgery, (3) surgical removal by the abdomino-perineal route (completed in one or two stages), (4) perineal resection preceded by a colostomy. Any of the above methods is capable of producing satisfactory results in properly selected cases.

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A brief analysis of the variable factors presented in a miscellaneous group of cases indicates rather clearly why selective treatment is superior to any routine method

A—*The general condition* of the patient should be given preliminary consideration. Old age, poor general health, and obesity, occasionally contraindicate employment of the most effective surgical procedure, or forbid intensive applications of radiation therapy. The majority of patients withstand the latter better than radical surgery. Abdomino-perineal resections are accompanied by a higher mortality than those through the perineum. Therefore, even though the disease may not be far advanced, palliative measures may be preferable in certain aged, debilitated, or very obese patients.

B—*Location and accessibility of the tumor* have considerable bearing upon the method of choice. From the surgical standpoint, location often determines the method of procedure. Tumors of the recto-sigmoidal juncture are usually removed by the abdomino-perineal operation, and tumors of the mid and lower rectum by the less radical procedure of a perineal resection preceded by a colostomy. However, when surgery is indicated, the grade of malignancy, together with the location of the tumor, must be taken into consideration. If the pelvis is large, small tumors at the recto-sigmoidal juncture, which are of low-grade malignancy, may be successfully removed by the perineal route, whereas highly malignant tumors in a lower location are seldom completely removed by surgery alone, except by the more complete abdomino-perineal dissection. The accessibility of the tumor may also largely determine the value of radiation therapy. Unless the tumor is sufficiently radiosensitive to disappear after external radiation, interstitial radiation is required. Adequate interstitial irradiation is obtained by uniform distribution of the proper dose by means of radium seeds. When the tumor is accessible, this effect is not difficult to obtain. However, there are inaccessible tumors that do not lend themselves to adequate interstitial irradiation.

C—*Size and fixation of the primary mass* are important factors with respect to treatment and prognosis. Surgical interference to be successful requires the removal of all malignant cells. The size of the tumor mass within the rectal wall is of less importance than is the degree of extension of the disease into the surrounding tissues. The extent of infiltration in tumors of highly malignant character may be difficult to determine by palpation. When radium implants are required the size of the mass is important, since adequate dosage is determined by the size and the radiosensitivity of the tumor.

D—*The wide variation in the degree of malignancy* of cancer in this vicinity is manifested clinically in the consideration of a miscellaneous group of untreated cases. The average duration of the disease from the onset of objective symptoms in this group is about two years, patients with the most active form of rectal cancer seldom live more than twelve months, although patients with less malignant tumors may live three or more years.

There are two methods of determining the grade of malignancy of rectal cancer. First, by histopathological study of a small section of the tumor. Secondly, by clinical data secured from a detailed history and from a general and local examination of the case.

1 Histopathological grading may furnish an estimate, in a certain percentage of cases, of the degree of malignancy. Sections must, however, be

provided which contain the true characteristics of the primary tumor. As secondary infection tends to alter these characteristics, it is not always possible to estimate the grade of malignancy from a biopsy of an ulcerating rectal cancer. When pathologists, however, are given the gross specimen and can select the area for study, then the pathological classification is quite satisfactory. While a biopsy report indicating the grade of malignancy is valuable, nevertheless, too great importance should not be attached to it unless such report is in keeping with the clinical data of the case.



FIG 1—Slowly growing, late infiltrating and very late disseminating

2 The clinical data presented in the average case when referred for treatment is usually sufficient to determine to an approximate degree the grade of malignancy. Such data include the age at which the cancer occurred, the effect of the disease upon the patient, the location, size, shape, induration and ulceration together with the appearance of the tumor when viewed through a proctoscope. The consideration of these factors suggests a clinical grading of malignancy of rectal cancer corresponding to the rapidity of growth, rate of infiltration, and trend toward dissemination of the tumor. The following more or less definite five groups are suggested: (a) Slowly growing, late infiltrating and very late disseminating (this type has a marked tendency to early stenosis), (b) uniformly growing, infiltrating and disseminating, (c) rapidly growing, early infiltrating and late disseminating, (d) slowly growing, early infiltrating and moderately early disseminating, (e) slowly growing and late infiltrating, early disseminating types.

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(a) The stenosing, slowly growing, slowly infiltrating and very late disseminating type (Fig 1) is most commonly found in old age. The early symptoms are obstructive in character. Ulceration is superficial and does not occur early. The discharges of mucus are seldom frequent and are stained with blood only at irregular intervals. These tumors are very firm and there is but a slight outgrowth into the lumen, they have, however, a tendency to encircle the bowel, a condition which produces a constriction rather than an obstruction. Due to the lack of vascularity, and a large amount of fibrosis, trauma produces but slight bleeding. The recto-sigmoidal juncture is the most common location for these low-grade malignant tumors which cause but slight impairment of the general health until obstructive symptoms are marked.

(b) The second group in which there is more or less uniformity in the rate of growth, rate of infiltration and dissemination (Fig 2)

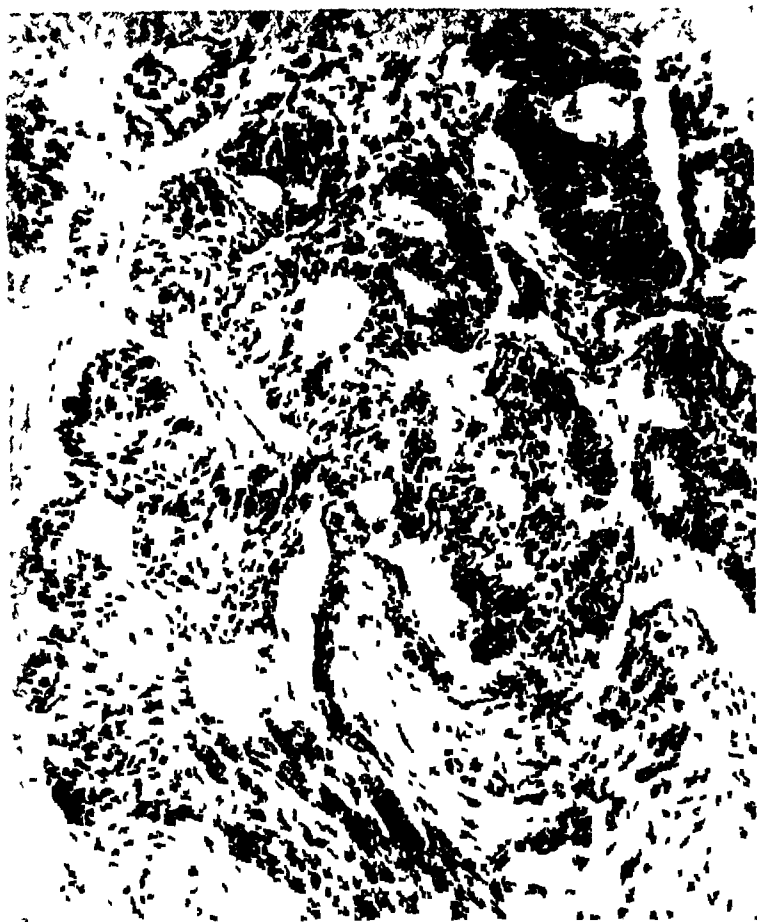


FIG 2—Uniformly growing, infiltrating and disseminating

includes more than 50 per cent of rectal cancers. This type is occasionally found in young subjects but usually occurs in patients between forty-five and sixty-five years of age. The history is that of a gradual onset, the subjective symptoms being followed by objective symptoms of increasing severity. The duration of the disease in untreated patients varies between eighteen months and three years. The tumor enlarges at rather a slow rate and attains considerable size before there is infiltration beyond the muscle coat. The disease extends by continuity of tissue rather than through the lymphatic and blood streams until the primary mass is definitely fixed. One can usually predict the amount of dissemination by the duration and severity of symptoms, by the effect upon the patient, and by the size, degree of fixation, and infiltration of the tumor, since dissemination is proportionate to the degree of these other factors. Palpation and proctoscopy of this type of tumor present rather a typical picture. Although these cancers are small and freely movable with the rectal wall in the early stages, they are seldom

recognized at this time. Increasing in size, they tend to protrude into the lumen of the bowel and produce a variable degree of obstruction. Induration is about midway between that of the very cellular and the scirrhous varieties. Ulceration is superficial in the beginning but gradually becomes deeper and involves a large area. Areas of degenerated tissue may be



FIG. 3.—Rapidly growing early infiltrating and late disseminating

found but the bulk of the mass is moderately vascular as shown by the amount of bleeding when trauma is induced by the proctoscope.

(c) The majority of the rapidly growing, early infiltrating, and late disseminating cancers (Fig 3) occur in women between the ages of twenty and thirty, although this very malignant type of cancer may be found in patients of more mature years. In this grade of malignancy the disease is seldom recognized until the greater part of the circumference of the bowel is involved. Many of our

patients had been subjected to an abdominal or pelvic operation before the true nature of the disease was determined. The tumor enlarges rapidly and infiltrates the adjacent structures early in the course of the disease, while at the same time the mucous membrane is pushed inward. In many instances annular stricture occurs before ulceration has taken place. When the mass has attained considerable size, ulceration rapidly involves a large area. Induration is less marked than in the types previously mentioned. Before the onset of ulceration the symptoms are mild and the general condition of the patient is not seriously affected but after ulceration there is a marked change, manifested by anæmia, loss of weight and strength, and by increased irritability of the rectum. Many of these tumors are the seat of deep secondary infection which produces an elevated evening temperature. Although this type of tumor tends to infiltrate the adjacent tissues early, it does not disseminate to distant locations until the terminal stage. The appearance varies with the degree of ulceration and degeneration.

(d) The slowly growing, early infiltrating, and moderately early dis-

seminating type (Fig 4) is frequently discovered in young or middle-aged males. Its favorite location is the anterior quadrant of the lower rectum. The rate of enlargement is slow but ulceration of the mass and infiltration beyond the muscle coat occur early, being often accompanied by dissemination into the nearby lymphatic nodes, although the liver may not be involved until the advanced stages of the disease. These slowly growing tumors present a picture entirely different from that of the rapidly growing types. When first recognized they are usually small, although the objective symptoms have been in evidence for several months, they are usually sessile and protrude slightly into the lumen of the bowel, there often exists a deep ulcerating crater on the surface. Early infiltration causing partial fixation occurs at a site adjacent to the crater. These moderately indurated tumors bleed easily when traumatized. Constriction of the rectum never takes place

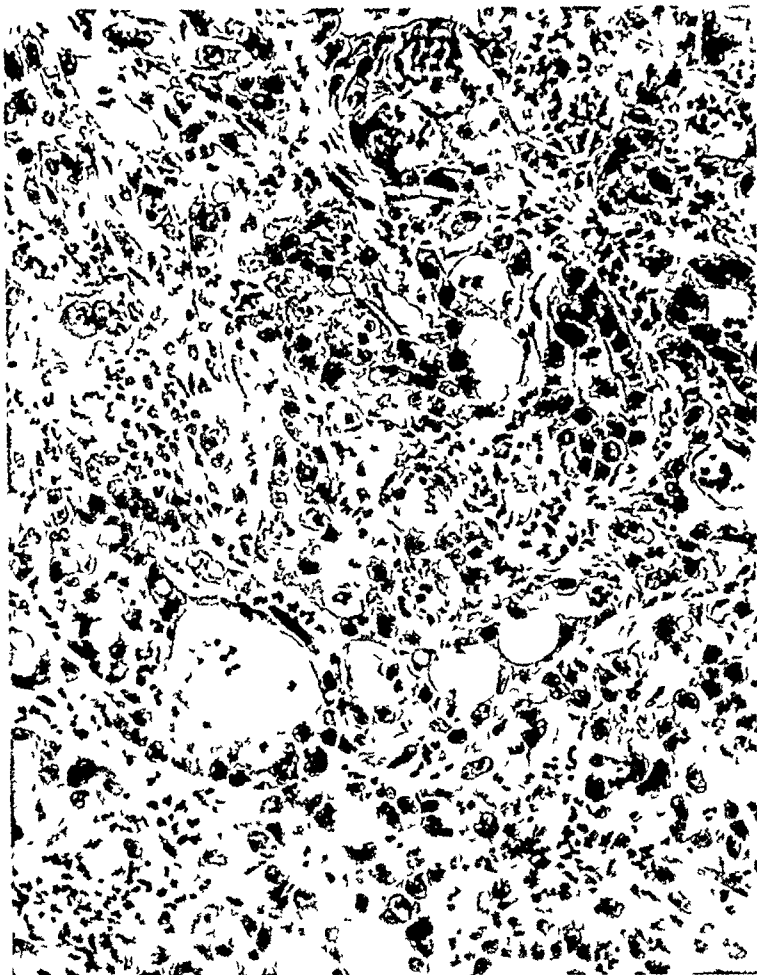


FIG 4—Slowly growing, early infiltrating and moderately late disseminating

early. The real criterion by which the extent of the disease may be recognized lies in an accurate determination of the extent of the infiltration, as the general health is not noticeably affected until definite fixation has taken place.

(c) The latter two clinical types (*ie*, the third and fourth) tend to infiltrate early into the adjacent structures and the nearby lymphatic nodes, while the characteristic feature of the fifth, the slowly growing, early disseminating type, is early migration of the cancer cells to distant locations. The rapidity with which this occurs suggests spread by way of the blood stream, rather than by the lymphatic route. Although this type is comparatively rare, nevertheless two clinical varieties are recognizable—one, a stony hard tumor with very superficial ulceration, is usually circular and may be freely movable with the rectal wall at the time of the primary examination, the other, early disseminating variety is somewhat similar to the slowly growing, early infiltrating type except that it has greater consistency and is usually deeply infected. Early disseminating tumors occur

at all ages, but are most common between the ages of forty and sixty-five years. The local symptoms are usually comparatively mild but also vary in accordance with the degree of ulceration.

The separation of rectal cancer into the above five clinical types offers a working classification in this disease. Although a number of typical malignant tumors such as adenomas and papillomas undergoing malignant changes, colloid cancers, etc., will be observed, there is but little difficulty encountered in placing them within their appropriate group. The importance of determining the degree of malignancy of a given rectal cancer is self-evident if the most appropriate treatment is to be adopted. Cancers which have slowly infiltrating and disseminating characteristics remain a local disease for many months and may be eradicated by methods of moderate intensity, whereas highly malignant cancers such as those comprising the latter three groups demand more radical treatment.

E—Radiosensitivity of rectal cancer. Experience has proven that there is a marked variation in the degree of radiosensitivity of the rectal cancer. This important factor influences the selection of treatment and governs the intensity of radiation therapy. Tumors of low-grade radiosensitivity may often be influenced to the same degree as those of the most radiosensitive nature by employing more intensive irradiation at the site of the mass.

The classification, operable or inoperable, from the point of view of treatment is largely based upon the condition of the patient, the location of the tumor and degree of fixation of the primary mass, together with the possible existence of metastatic lesions. More recent observations in rectal carcinoma reveal the importance of the latter two factors, namely, the degree of malignancy and the degree of radiosensitivity of the cancer cells, which should be considered in forming a workable classification. If these additional factors are to be considered a part of the basis of classification, the division into favorable and unfavorable groups appears more appropriate than the former surgical classification of operable and inoperable. Unless recognized very early in the course of the disease, tumors of the more malignant grade tend often to recur after surgical removal, consequently, despite the fact that they appear operable, they are usually unfavorable for surgery because of this tendency. Unless the grade of malignancy is determined, digital examination will often convey the erroneous impression that all the cancer cells can be removed. On the other hand, tumors that are definitely fixed and in which surgical removal is impossible, may have a favorable outcome, provided the disease is amenable to radiation therapy. The prognosis therefore depends on the radiological, as well as the surgical aspects of the case. Patients constituting the favorable group are those in whom there is a prospect of at least a three-year "clinical cure."

Previous to the institution of radiation therapy, radical surgery was the only method of treatment by which it was possible to hope for eradication of rectal cancer. A comparative review of the literature indicates that about 60 per cent of the cases are considered operable, that of those operated upon the immediate mortality is about 16 per cent, and that only 25 per

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cent to 30 per cent of the patients surviving the operation are alive at the end of three years. Assuming that these figures represent the true status of surgical treatment, we have only 12 per cent to 15 per cent of patients with cancer of the rectum alive at the end of three years, after 60 per cent have been submitted to a radical operative procedure. The small percentage of satisfactory results following radical surgery in the so-termed operable group, and the lack of palliation provided by surgery in the inoperable group, encouraged the investigation of other methods of treatment. The reports of Janeway,¹ Quick,² Kelly and Ward,³ and others, demonstrated the importance of radium applications in the treatment of this disease. The gradual improvement of the technic in the use of the physical agents⁴ over a period of ten years has greatly increased the appreciation of this method of therapy. In addition, observation of patients treated with radium and high voltage Rontgen rays have led to a more discriminating selection of cases and to a more satisfactory treatment of rectal cancer in general. Although radiation therapy has its limitations, nevertheless it is capable of producing satisfactory results in selected cases, and often affords an additional advantage when combined with the most suitable forms of surgery. Moreover, it provides valuable palliation in many patients of the unfavorable group.

The course of treatment for each case classified as favorable is outlined at the beginning and each step is carried out in systematic manner. Satisfactory results seldom follow haphazard technic. The various steps contemplated may consist of external radiation, interstitial radiation, colostomy, and radical excision. In accordance with the intensity of treatment required, favorable patients are divided into the three following classes: (a) Those in whom external radiation alone is sufficient, (b) those who require both external radiation and interstitial radiation (a colostomy may or may not be an advantage), (c) patients in whom a combination of radiation therapy and radical surgery offers the greatest possibilities. The surgical procedure in the latter class is determined by the extent of the disease, location of the tumor, degree of malignancy, and condition of the patient.

EXTERNAL RADIATION—The chief factor upon which the efficiency of external radiation depends is the radiosensitivity of the cancer cells. All rectal cancers are deep seated. The distance from the skin surface to the tumor varies according to location of the tumor and size of the pelvis. Cancers situated near the surface obviously receive a higher percentage of the skin dose than those situated at a greater distance. External radiation not only affects the primary focus but includes within its field of activity the surrounding lymphatics. The employment of sufficient portals of entry about the pelvis allows for a more or less uniform influence to be exerted upon the primary mass and the surrounding area. Consequently external radiation, when adequate, is not only the ideal method of radiation therapy but the ideal method of treatment for rectal cancer.

The most efficient form of external radiation is by means of the radium

pack When sufficient radium is not available for this form of applicator, high voltage Rontgen rays may be substituted The best results, however, appear to follow the combined applications of radium and high voltage Rontgen rays with radium predominating

Dosage—Three to seven portals of entry about the pelvis are usually employed, with a maximum dose for each of about 50,000 to 60,000 millicurie hours of radium, when used at fifteen centimetres from the skin, plus an application of high voltage Rontgen rays The time required for external applications, depending upon the size of the dose, is usually two to six weeks Slight variation in dosage of these two agents is required with different patients, the skin tolerance determines the maximum amount of external radiation at each portal The skin must not be permanently damaged but slight blistering is of no consequence Unfortunately, owing to the low degree of radiosensitivity of malignant tissue, and to the depth of the tumor mass from the skin surface, and also the susceptibility of the skin to irradiation, sufficient dosage of external radiation cannot always be given to cause a complete disappearance of the disease Under these circumstances, additional treatment is required

The following report of a case treated by external radiation alone, reveals the importance of this method of application

A male, fifty-seven years of age, in fairly good physical condition, was referred to the Memorial Hospital, November 14, 1927 *History* Symptoms began in July, 1927, with an attack of diarrhoea The stools at that time contained considerable blood and mucus, during the four months prior to admission he passed mucus unstained with blood six or seven times daily There was marked flatulence and difficulty in obtaining satisfactory evacuation of the bowels He tired easily and had lost ten pounds in weight Local examination revealed an indurated mass involving the anterior two-thirds of the circumference of the rectum, the lower limits of the mass extended to within eight centimetres of the anal skin margin The size of the tumor was estimated to be about $2\frac{1}{2}$ by $3\frac{1}{2}$ centimetres There was superficial ulceration over the area of the tumor which protruded slightly into the lumen of the bowel The exact extent of infiltration and the degree of fixation could not be determined because of unsatisfactory palpation A moderate amount of bleeding was produced by the proctoscope and by taking a section for biopsy *Pathological report* Adenoma malignum, grade II, cells small, probably radiosensitive Treatment consisted of applications of high voltage Rontgen rays and external applications of radium with the four-gram element pack The pack was employed at 15 centimetres from the skin *Dosage* Between November 28 and December 12 this patient received an application of high voltage Rontgen rays over four areas, the anterior and posterior right and left pelvis Treatments consisted of sixty-minute exposures with four milliamperes of current This pelvic cycle was repeated between January 3 and January 13, 1928 An application of high voltage Rontgen rays was given over the perineum January 20 and repeated March 9, 1928 Radium applications given from February 16 to March 2 amounted to 55,000 millicurie hours of radium at 15 centimetres from the skin over the centre of the pubes and lower abdomen, and 55,000 millicurie hours, posteriorly over the sacrum *Progress of the case* January 3—patient felt somewhat improved January 14, further improvement in the general condition, a decrease in the amount of mucus discharge, and a slight reduction in the size of the tumor The ulcerating area which was noted at the first examination was completely covered with epithelium January 31, patient was free of symptoms, with marked

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improvement in the general condition and further reduction in size of the tumor. March 30, the tumor in the rectum had completely disappeared. This patient has gained twenty-five pounds in weight and remains free of recognizable cancer.

INTERSTITIAL RADIATION—A number of methods of applying radium have been attempted in the effort to supply adequate irradiation at the site of those tumors in which external radiation was insufficient for eradication. These methods consisted of placing radium or the emanations of radium adjacent to, or into the tumor mass. Surface applicators, or tubes arranged in tandem, placed within the rectum adjacent to the tumor, received great popularity for a time. This form of application was only of low-grade palliative value and was accompanied by a severe proctitis and tenesmus. The implantation of element and large emanation needles into the mass was also accompanied by severe reactions and indefinite results. The most effective of the earlier methods was implantation of small glass emanation seeds into the tumor. The reaction following this method was, however, very severe. Because of the ineffectiveness and the severity of the reactions, the above methods are no longer employed at Memorial Hospital. Since 1925, the method of choice has been the implantation of gold-filtered radium emanation seeds. Utilization of the gold filter for emanation seeds introduced a new phase in the radium therapy of rectal cancer.

Interstitial radiation by gold seeds may be employed alone as a method of treatment, although we prefer to use it after preliminary external radiation since this latter includes a large area of lymphatics within the field of treatment. After external applications the ulcerating area is decreased in size, the tumor is smaller, and the external limits are more easily defined. These alterations facilitate a more accurate calculation of the dose and provide a more suitable field for the implants. An interval of one to two weeks is allowed to elapse between external and interstitial applications.

Gold seeds are five to six millimetres in length, $75/100$ millimetres in diameter, with a filter of $3/10$ millimetres of gold. They vary in strength from one to three millicuries. Seeds of 1 to $2\frac{1}{2}$ millicuries are the most serviceable for routine application. The seeds are distributed throughout the mass and left *in situ*. The dose required depends upon the size and radiosensitivity of the tumor, and should be of sufficient strength, in favorable cases, to eradicate the lesion in one application. Secondary applications are less effective and are usually followed by infection and necrosis. The amount of emanation required may vary between 10 millicuries (1300 millicurie hours) and 65 millicuries (8500 millicurie hours).

As success or failure depends upon the proper placing of the adequate dose of emanation seeds, careful consideration must be given to minute details. The seeds are implanted by the aid of long trochar needles. Their exact location in the malignant mass is determined by direct vision or by the sense of touch. When the tumor is low in the rectum, the index finger is placed within it to guide proper placement. The trochar needles are then inserted

into the tumor by passing them either through the lumen of the anal canal or the normal perineal tissues or, in the female, through the posterior vaginal wall. Tumors situated at a higher location require the employment of an electrically lighted proctoscope. The patient is placed in the position which affords the best view of the tumor, the instrument is passed into the rectum and the actual placing of the seeds is determined by direct vision. A clear field for implantation is maintained by suction. If marked stenosis prevents a satisfactory view of the tumor, a preliminary colostomy may prove an advantage. In the construction of an artificial anus to facilitate the insertion of seeds, the section of sigmoid between the colostomy and the tumor is left comparatively short in order that a proctoscope may be passed downward through the artificial opening to the upper limits of the mass. By inserting seeds into the upper area of the tumor by way of the colostomy and into the lower section by way of the anal canal, the most adequate interstitial radiation is provided in the stenosing cases.

The following case illustrates the use of external radiation and the implantation of gold seeds.

A male, fifty-eight years of age, was referred for treatment November 26, 1926. *History* Increasing constipation for sixteen months, frequent discharges of mucus, and pain at evacuations. There was only a slight loss of weight. Local examination revealed an indurated mass about three centimetres in diameter in the posterior quadrant of the lower rectum. *Pathological report* Adenoma malignum. *Treatment* Between November 30 and December 6, 1926, the patient received four high voltage Rontgen-ray treatments. December 1, external application of radium, totaling 18,000 millicurie hours, at ten centimetres from the skin, was administered posteriorly over the sacrum. December 4, he received 39 millicuries of gold seeds (5000 millicurie hours) into the tumor. There was a moderate reaction following the dose of gold seeds. This patient has remained free of recognizable cancer since April, 1927.

Use of Radium and Radical Surgery—External radiation and the implantation of gold seeds appear to offer additional assurance against recurrence to that afforded by surgery alone. The principal factors which determine the success of surgical interference are the ability of the patient to survive the operation and the possibility of removing all the cancer cells. The common locations of malignant cells which are not removed by surgery are the nearby lymphatics and the tissues adjacent to the indurated primary focus. The object of pre-operative radiation is to affect the malignant cells sufficiently to cause partial devitalization, prior to their resection, since radiation therapy influences a larger area of lymphatics and adjacent tissues than can be included within the field of dissection. Pre-operative therapy is preferable to post-operative therapy for the reason that the tumor will serve as a suitable holder for the radium. After surgical removal, it is impossible to recognize remaining small groups of malignant cells. Nevertheless, post-operative irradiation is at times exceedingly valuable, especially when the tumor does not lend itself to adequate pre-operative therapy, and in those cases in which only a small localized area of cancerous tissue remains.

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Intensive treatment by radiation therapy and radical surgery consists of four steps which are usually carried out in the following order (1) External radiation, (2) preliminary colostomy, if indicated, (3) interstitial irradiation with the use of gold seeds in which large doses of emanation may be employed, (4) resection of the rectum. This latter procedure should be done ten to fourteen days after the implantation of gold seeds. The painful reaction ordinarily following in the diseased tissue after the use of large amounts of radium is prevented by early resection of the rectum. Special care is exercised in placing the seeds so that sterilization will be obtained in the infiltrating areas. The difficulties of surgical removal are not increased by implantation of the seeds unless an interval longer than the above is allowed to elapse between these procedures.

The type of radical operation is governed by the clinical and pathological factors of the case. The diversity of opinion as to the more suitable surgical method of approach will be greatly reduced when the degree of malignancy of rectal cancer is given equal consideration with the extent of tissue involved, and the condition of the patient.

The following case report illustrates the combined method of treatment.

A male, sixty-one years of age, was referred for treatment June, 1926. *History* Rectal trouble characterized by attacks of diarrhoea, frequent discharges of mucus and blood, and a feeling of weight in the pelvis, had been present five months. There was a loss of twenty pounds in weight since the onset of the symptoms. Local examination revealed a stenosing cancer in the lower rectum which had infiltrated the adjacent structures deeply on the left side. *Pathological report* Adenoma malignum. *Treatment* Between June 30 and July 27, this patient received four high voltage Rontgen-ray applications. July 27, 37 millicuries of gold seeds (4800 millicurie hours) were implanted into the mass. A colostomy was performed July 31 and the rectum resected by the perineal route August 11, 1926. This patient made an uneventful recovery following his operation and has remained free of recognizable cancer.

COLOSTOMY—In the treatment of rectal cancer, the question arises in every case as to the advisability of performing a colostomy. As an artificial anus is always an inconvenience, it should be dispensed with in all favorable cases, except those in which it affords an additional advantage to treatment. If the disease can be eradicated by external radiation, there is no advantage in this procedure unless the bowel is completely obstructed. A colostomy is an advantage in about 50 per cent of cases which require the implantations of gold seeds. In cases requiring radical resections, an artificial anus is often a life-saving procedure. Moreover, exploration of the abdomen at the time of operation may aid materially in determining the prognosis of the case.

Patients primarily considered unfavorable or inoperable are too often subjected to this unpleasant procedure, which the debilitated find especially trying, because of the former teaching that all inoperable cases of cancer of the rectum should have a colostomy. This belief originated prior to the employment of efficient radiation therapy. Nevertheless, a certain percentage of the unfavorable cases are benefited by this procedure, especially those with considerable stenosis of the bowel with indications for heavy or moderately

intensive palliative treatment In the more advanced stages of the disease, unless there is practically a complete obstruction, an artificial anus is contra-indicated The advancement of the technic of radiation therapy during the past few years has greatly lessened the necessity for this surgical procedure

Treatment of the Unfavorable Cases—The frequency with which rectal cancer is allowed to progress to an unfavorable stage before recognition increases the importance of palliative measures Palliative treatment, through restraint of growth, tends to lessen the symptoms, to improve the general condition, and to prolong life These results are best obtained by radiation therapy, although a colostomy is, at times, an advantage Space will not permit a discussion of the details of the management of these unfortunate patients There is no routine dose or routine method of radiation therapy for this type of case Each patient must be considered as an individual problem and treatment administered accordingly Patients of this group, however, may be divided into three classes in accordance with the intensity of the radiation therapy they require (a) Cases suitable for intensive palliative treatment, (b) those suitable for treatment of moderate intensity, (c) cases suitable for minimal treatment The first class usually receives external radiation and implantation of gold seeds The intensity of such treatment is sufficient to control the disease completely for a time Applications are repeated in accordance with the progress of the case, which by this means may obtain marked palliation for a long period The second class, patients suitable for treatment of moderate intensity, may receive external radiation, or interstitial radiation, or a combination of both forms The disease may be only partially controlled by these small doses, intensity of treatments and the interval between applications are determined by the patient's condition and response to therapy

If cases are poorly selected or over-dosage employed, the result may be harmful Many mistakes have been made by attempting to obtain impossible results by employing too intensive radiation therapy

The following case report illustrates palliative treatment in an unfavorable case

A male, fifty-six years of age, was referred for treatment July 28, 1924 *History* Constipation existed for many months, with pain in the pelvis and frequent discharges of mucus and blood for six months, and a loss of fifteen pounds in weight Rectal examination revealed a large definitely fixed tumor in the mid-rectum The mass involved the greater part of the circumference of the bowel and produced an almost complete stenosis of the lumen *Pathological report* Adenoma malignum *Treatment* A colostomy was performed July 30, 1924 after the condition had been termed inoperable Applications of high voltage Rontgen rays were given August 15 and August 18, 1924 On August 12, 15 millicuries of unfiltered emanation seeds were implanted into the mass and on November 18, another application of $7\frac{1}{2}$ millicuries was administered During 1925, this patient received the following treatment Fourteen high voltage Rontgen-ray applications administered about the pelvis, and 27 millicuries of gold-filtered seeds implanted into the mass In 1926 12 high voltage Rontgen-ray treatments were given and an implantation of 12 millicuries of gold seeds were implanted into the lower limits of the tumor He has not received any treatment since September, 1927 At

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present his general condition is good. He is free from pain and leads a comfortable life. A large mass still remains in the rectum and he has occasional discharge of mucus. The early treatment of this case differed from that of today in that the glass seeds have been replaced by gold-filtered seeds, and sufficient radium is now available for external applications.

Reactions following Applications of Radiation Therapy—The dangers and sequelæ of radical surgery are well known, but comparatively few of the profession are familiar with the reactions of radiation therapy that follow the present-day technic. In the experimental stage, the reactions were often unnecessarily severe, because of crude methods of application, improper selection of cases, and the too great doses of radium employed. The severity of reaction has been greatly reduced by the improved technic in the application of radium and by a better selection of cases. External applications do not produce severe reactions. Seldom is the patient affected sufficiently to interfere with his daily routine, but occasionally he will complain of slight loss of appetite, malaise or nausea, but vomiting is rare. These mild reactions, if they should occur, may be lessened or stopped by decreasing the time of exposure and lengthening the period between applications.

Reactions following the implantation of gold seeds depend largely upon the location of the tumor, the degree of infiltration into the areas liberally supplied by nerve filaments, the size of the dose of radium and the degree of secondary infection of the mass. In the majority of instances, if adequate radiation is employed, the reaction will not be severe. However, there are cases in which the desired result cannot be obtained without a moderately severe reaction. Provided that appropriate radiation therapy is employed the effect upon the patient is much less severe than that produced by radical surgery. It is only reasonable to expect a certain amount of discomfort from any form of treatment that is capable of producing a satisfactory result in rectal cancers. However, the dangers of adequate radium therapy cannot be compared with the dangers of radical surgery.

RESULTS

The results of treatment in rectal cancer at Memorial Hospital have shown a gradual improvement. This has been brought about largely by a more appropriate selection of cases and by a gradual improvement in the technic of radiation therapy. The latter factor has been greatly enhanced by changing the character of the filter.

The majority of patients that have been referred for treatment have been inoperable cases. Prior to June 1925, at which time gold seeds were first used in the treatment of this disease, various methods of interstitial irradiation were employed and but little attention was devoted to the proper selection of cases. However, of the patients treated previously to this date, eighteen are alive and free of recognizable cancer over periods varying from three and one-half to eight years.

A cross-section of the more recent work is shown by an analysis of the patients treated between June, 1925, and June, 1928. Of the cases treated during this period, there were 153 complete follow-up records. Of these, 32 were considered favorable and 121 unfavorable, with the unfavorable group divided as follows: 30 suitable for intensive palliation, 64 suitable for moderate palliation, and 27 suitable for minimal treatment.

In the treatment of the favorable group radiation therapy was supplemented with radical surgery in nineteen instances. Twenty-three (72 per cent) of the favorable group are alive and clinically free of recognizable cancer, 4 are alive and in good general condition, while 5 are dead. One patient died of intercurrent disease, 3 died following operation, while 1 died of acute yellow atrophy of the liver several months after treatment. The post-mortem examination of this case failed to show any evidence of cancer.

Radiation therapy in the unfavorable group produced a lessening or disappearance of the symptoms and in many instances a marked prolongation of life. Of the 30 patients who received intensive palliative therapy, 11 are dead, 12 are in fairly good general condition, 4 are practically symptom-free, while 3 are free of recognizable cancer. Post-mortem examination in one case of this group (in which death occurred after several symptom-free months) failed to show either gross or microscopic evidence of cancer. The effect of radiation therapy on fourteen cases receiving only moderate intensive treatment, was chiefly manifested by a decrease in severity of symptoms and by a marked temporary improvement in general health. Ten of these patients are still alive and in fairly good condition.

CONCLUSIONS

- 1 Efficacy of radiation therapy in the treatment of rectal cancer has been greatly increased by improvement in technic.
- 2 Reclassification of rectal cancer from the standpoint of the degree of radiosensitivity and of malignancy has resulted in an improved treatment of this disease.
- 3 Utilization of radical surgery as an adjunct to treatment by radiation therapy is often the method of choice.
- 4 The effects of treatment of this disease by any single method or combination of methods are greatly enhanced when an early diagnosis has been established.
- 5 Recognition of the degree of malignancy is suggested as the determining factor in the choice of surgical route, whether abdomino-perineal or perineal, if surgery is indicated.

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SIGMOIDOVESICAL FISTULÆ

WITH SPECIAL REFERENCE TO SIGMOID DIVERTICULITIS

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OBVIOUSLY present, because of passage of gas and particles of feces from the bladder, the cause of sigmoidovesical fistula in any given case will be difficult to determine. Probably the most frequent origin is from an abscess developing from a diverticulum of the sigmoid which ruptures into the bladder. Carcinoma of the upper rectum is probably next in frequency as a causal factor. Because of the rather protean manifestations of diverticulitis of the colon, and the relative lack of emphasis placed on this subject in surgical literature, a brief résumé of our knowledge of diverticulosis of the colon will be attempted.

It must be emphasized that diverticula of the colon occur frequently without symptoms, and as far as is known without being inflamed. In 1924 one-third of all the X-ray examinations of the colon at The Mayo Clinic revealed diverticula.¹ Spriggs,² of London, who has been particularly interested in this subject, found diverticula in 8 per cent of the radiological examinations of the colon he had made. He reports 158 patients with diverticulosis, as follows:

One hundred and sixteen pelvic colon, 76 descending colon, 30 ascending colon, 31 transverse colon, 23 with whole colon involved, 7 in cæcum, 4 in rectum.

The average age of patients with diverticula of the colon is from fifty-five to fifty-eight years. Ashhurst³ reported one patient seven years of age with this condition. One of the outstanding contributing factors seems to be adiposity, most of the patients being overweight. Constipation, which may be the result rather than the cause, is emphasized by most writers on this subject, stress being laid on the importance of increased pressure from within the bowel, from gas or hardened feces. Spriggs states as his belief that the condition is a disease and is the result of an infectious process. As diverticula formation is not uncommon, on occasion, in the whole gastrointestinal tract, as well as in the urinary bladder, congenital anatomic variations must, it seems to me, be considered.

From a pathological standpoint, diverticula of the colon are generally multiple, and consist of hernial protrusions of the mucosa of the bowel through the muscularis into the fat of the mesentery, or into the appendices epiploica. The relation of the blood vessels running into the bowel has been emphasized as a source of weakness in the bowel wall. The fat tags along the lateral mesenteric border are most affected (Judd). The most frequent changes developing in these diverticula are the result of infection, with subsequent inflammation. Fecaliths may develop in the pouches of the diverticula,

and become marble shaped and sized. In several instances I have seen a whole colon studded with fecaliths, numbering forty to fifty, and showing no signs of gross inflammation. When infection develops in a diverticulum of the colon a chronic inflammatory process usually develops, with induration of the fat about the diverticulum, adhesions between it and surrounding structures, and in some instances the development of an abscess. The inflammatory phenomena usually come intermittently, but when an abscess develops

it usually ruptures into the structure to which it is attached. This may be another loop of bowel, the rectum (Case I), the abdominal wall (Cases VII and VIII), or into bladder (Cases III, VI, VII and VIII). If the diverticulum was surrounded by omentum, or was adherent to the pelvic peritoneum, a peri-rectal abscess or a retroperitoneal abscess develops. If the infection in the diverticulum is acute, and previous inflammatory process has been absent, the diverticulum occasionally ruptures into the free peritoneum, with a resulting generalized peritonitis. Mummery⁴ reports three such cases, and T Warwick⁵ reports two others. I have knowledge of such a complication from which the patient died of a general peritonitis.



FIG 1—Case I. Diverticula of descending colon in a patient who had a sigmoidovesical fistula.

If, as in most instances the infectious process is chronic and repeated attacks of inflammation occur, with or without abscess formation, a chronic inflammatory thickening occurs in the colon, usually the sigmoid, which is hard and more or less fixed. The bowel in this region becomes narrowed by scar tissue and a stenosis occurs which may lead in unusual cases to obstruction of the bowel. The relation of carcinoma to the development of diverticulitis is not clear. There are those who believe that a tendency for carcinoma to develop in an inflamed diverticulum exists, while others do not. It is certainly true that carcinoma and diverticulitis rather frequently co-exist. In several cases

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I have seen at operation, the carcinoma was in no way different from that developing in a noninflamed colon

The symptoms of diverticulitis naturally depend on the inflammatory and infectious processes taking place in the diverticula, and vary from chronic spastic colitis with constipation to perforative pericolicitis with pelvic abscess, retroperitoneal abscess, bladder fistula, acute perforative peritonitis, or chronic stenosis of the colon with an inflammatory tumor. The most frequent manifestations are recurrent attacks of abdominal pain in the lower abdomen, and gas distension associated with constipation. Blood may be present in the stools (18 per cent, Judd), occasionally pus is present in the stools, while



FIG 2—Case I Sigmoidovesical fistula with filling defect in the sigmoid from chronic diverticulitis

excess of mucus is common. If the inflamed diverticulum is near the bladder, frequency of urination and burning urination is present. If the inflammatory process attaches itself to the bladder, pus in the urine is present. If the diverticulum ruptures into the bladder, gas and feces pass from the bladder on urination.

The diagnosis of the presence of diverticulosis is made not only on the history and physical examination of the patient, but by X-ray examination of the colon. In uncomplicated cases one has but to think of the possibility of these lesions to diagnose them. If the bowel wall is sclerosed by scar tissue, or a great amount of inflammatory reaction is present about the bowel, the diverticula may not fill, and only a filling defect of the bowel will be seen in the X-ray plate. In most instances a characteristic filling of the diverticula is seen, associated with their filling is a marked spasm of the colon which greatly exaggerates the haustra and gives the bowel the appearance of a

partially closed accordion. Proctoscopic examination should be made, but rarely is helpful. If a fistula is present barium may be seen running outside the bowel, or barium may be found in the bladder urine.

The differential diagnosis is by no means easy in complicated cases, where the thought of carcinoma of the sigmoid is ever present. Where diverticulitis of the colon has resulted, by reason of recurrent inflammation, in a narrowing of the colon, with or without an inflammatory tumor, accompanied by blood in the stools, the diagnosis may only be made by exploratory operation and, rarely, only by microscopic examination of the excised bowel. In attempting to marshal the facts in favor of such a lesion being due to diverticulitis, the time element is very important and the knowledge of the existence of the lesion over a number of years may make the diagnosis (Cases III and VIII). Diverticulitis is characterized by the intermittency of its symptoms, the passage of bloody mucus and pus in the stool is much more prominent in the history of carcinoma than in diverticulitis. The diverticulitis patient is in relatively better health and has no cachexia, or progressive loss in weight. Fever and leucocytosis is more common in diverticulitis. The presence of a sizable tumor mass in the sigmoid speaks more for diverticulitis than carcinoma, where the lesion is circular and not easy to palpate until late in the disease. The early appearance of chronic obstruction of the bowel is more characteristic of carcinoma. The X-ray examination of the colon showing a filling defect in the bowel, by weighing of detail, may be helpful in these doubtful cases, but is not usually decisive even though diverticula may be seen above and below the filling defect. In the most puzzling cases exploratory operation must be done, for when carcinoma comes seriously into question an immediate solution of the problem is imperative.

In patients developing a sigmoidovesical fistula a number of possibilities, as to cause, arise, though it must be said that diverticulitis is the most common. Carcinoma of the upper rectum and at the rectosigmoidal junction very commonly attaches itself to the base of the bladder, and late in the progress of the disease may rupture into the bladder, with the formation of a sigmoidovesical fistula. The differentiation between carcinoma and diverticulitis under these circumstances may be most difficult, if not impossible. In carcinoma the progressive tendency of the disease contrasted with the intermittency of the symptoms preceding the rupture is important. The more constant and earlier appearance of the blood and pus in the stools again speaks for carcinoma of the bowel. Where carcinoma is suspected at the rectosigmoidal junction proctoscopic examination may make the diagnosis, though frequently the lesion is just "around the corner" from the end of the proctoscope, due to fixation and narrowing of the bowel. Digital examination will reveal a mass in the cul de sac which is harder and less sensitive than the pelvic mass found in diverticulitis (Case IV). Cystoscopic examination is of great value, for not only is carcinoma of the bladder usually excluded, but the site of the fistula may be seen. If it is small it is most likely to be from a diverticulitis of the colon. If it is large and an ulcer, carcinoma of

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the bowel or bladder is usually the case. Biopsy of the suspicious tissue may make the diagnosis. This is not without risk, and may greatly increase an inflammatory reaction in the mass around the diverticulum, (Case VII)

Carcinoma of the bladder rarely perforates into the intestine. A diverticulum of the bladder may become infected and result in a pelvic cellulitis, but rupture into the bowel is rare, and results most commonly from operative procedures.

Tuberculous peritonitis, with abscess formation, frequently results in fistula formation after the abscess has ruptured through the abdominal wall or into abdominal viscera.

In the latter instance the bladder may become involved in an enterovesical fistula (Case V). In such an instance the previous history and onset of the disease is usually sufficient to make a diagnosis.

Carcinoma of the ovary, especially papillary carcinomatous cysts, may involve both the bladder and the bowel, resulting in a fistulous communication between the two.

Chronic infection of the tubes, with induration and long-standing abscess not infrequently causes a sigmoidovesical fistula. Tuberculosis of the tubes may also be responsible for such a condition.

Rarely, actinomycosis of the large bowel, echinococcus disease of the mesentery or pelvic organs may cause fistulous communication between the bladder and bowel. The diagnosis of the cause of fistula in these instances is not usually made except by operation or autopsy.

Traumatic lesions, either from gunshot wounds, fracture of the pelvis, or from operative procedures in the pelvis, may result in sigmoidovesical fistulæ, but here the causative factor is known.

The treatment of diverticulitis obviously depends on the secondary inflammatory changes taking place. If the symptoms are merely those of spastic colitis with attacks of annoying pain and gas formation, the patient should be given a diet rich in cellulose vegetables and cooked fruit to promote easy elimination without the use of cathartics or enemata. Rather continuous

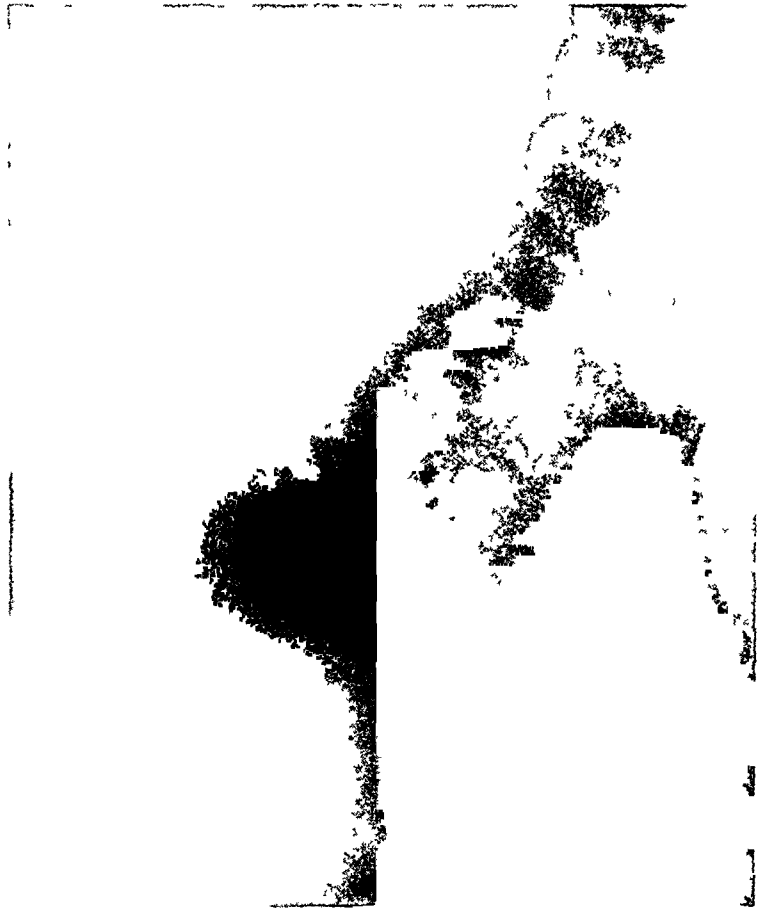


FIG. 3—Case VII. Filling defect
vesical fistula. Multiple

“ sigmoido

use of paraffin oil by mouth is helpful Calcium salts which predispose to fecalith formation should be avoided, as should bran, seedy fruit and vegetables Small doses of belladonna may be helpful in controlling spasms of the bowel

If an inflammatory mass develops, rest and a moderate degree of

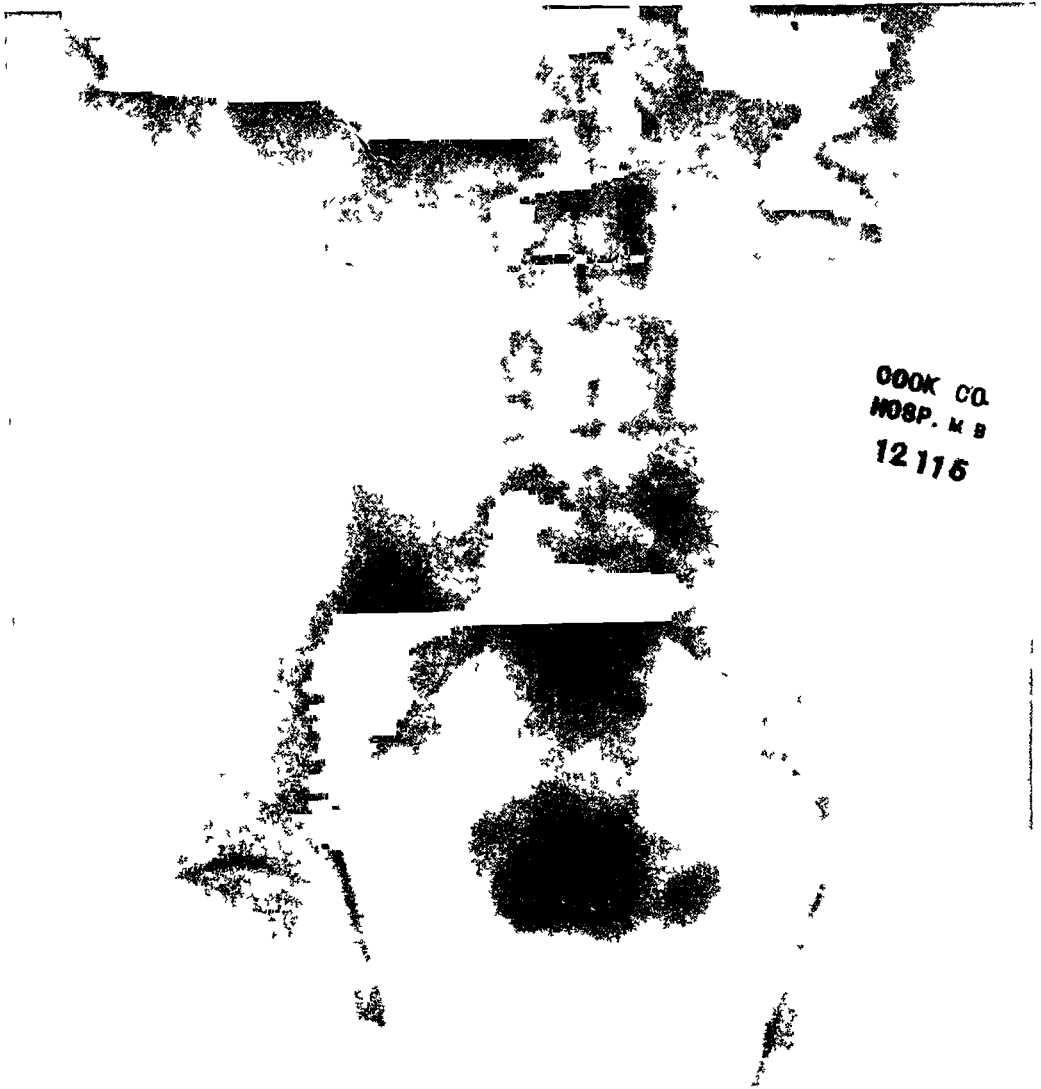


Fig 4

FIG 4—Case VIII Sigmoidovesical fistula X ray showing stones in bladder and pyelogram of left kidney

expectancy may result in its disappearance, but in such a condition a temporary colostomy above the mass may be necessary Resection of the involved bowel may have to be done later, but with sidetracking of the fecal stream by colostomy these inflammatory tumors often subside

If stenosis of the bowel results, preliminary colostomy followed by resec-

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tion of the diseased segment of the bowel may be necessary. Resection may be done by the Mikulicz graded method, or by other accepted methods. Mumma¹ resected the bowel in nine cases, with two deaths. He performed colostomy in fourteen cases. Rowlands⁶ reported fourteen resections, four of which were done because of the belief that the lesion was carcinomatous.



FIG. 5.—Case VIII. Sigmoidovesical fistula. Spastic colon.

In acute cases where abscess has formed the abscess must be drained. In acute perforative peritonitis immediate operation with attempt to close the source of the infection must be carried out.

In fistulæ between the bladder and the large bowel due to diverticulitis treatment must depend upon the severity of the symptoms. (a) If the process is acute, with marked cystitis and evidence of ascending infection, a colostomy should be done and the bladder drained by an indwelling catheter until the

acuity of the condition subsides, (Case VI) (b) In patients with an inflammatory mass between the bladder and the bowel, and the symptoms not being acute, expectancy may be tried with the hope that under rest the mass will subside, (Case VII) (c) Where the fistula is a chronic process and no acute symptoms are present a laparotomy should be done and the communication

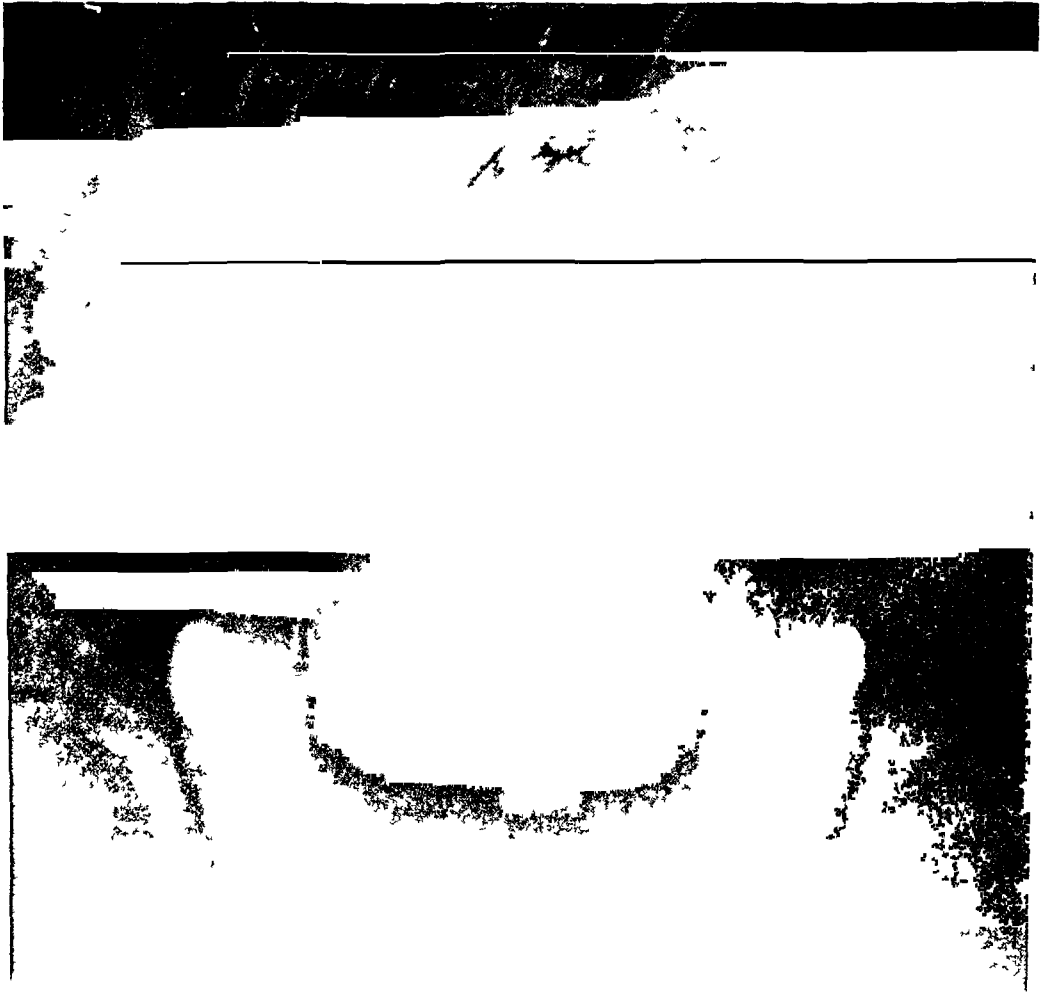


FIG 6—Case VIII Sigmoidovesical fistula Cystogram showing potassium bromide present in bladder and sigmoid

between the bladder and the bowel separated, with layer suture of each viscus Temporary colostomy is also usually indicated (Cases VI and VIII) (d) In old persons who have had a small sigmoidovesical fistula for years, and the urinary tract has gained tolerance to fecal contamination operation may be deferred (Case VI)

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CASE REPORTS—CASE I *Rupture of abscess from diverticulitis of the sigmoid into the rectum*—Mr A, aged fifty years The patient has had intermittent attacks of cramp-like pain associated with gas formation in the lower abdomen for several months A week before entrance into the hospital he had a chill, followed by temperature, developed soreness in the lower abdomen, followed by the passage of a considerable amount of blood and pus from the rectum Proctoscopic examination revealed an inflamed area above the prostate on the anterior side of the bowel from which a small amount of pus was escaping After these symptoms had subsided, X-ray examination revealed multiple diverticula of the sigmoid

CASE II *Retrosigmoidal abscess, probably due to diverticulitis of the sigmoid*—

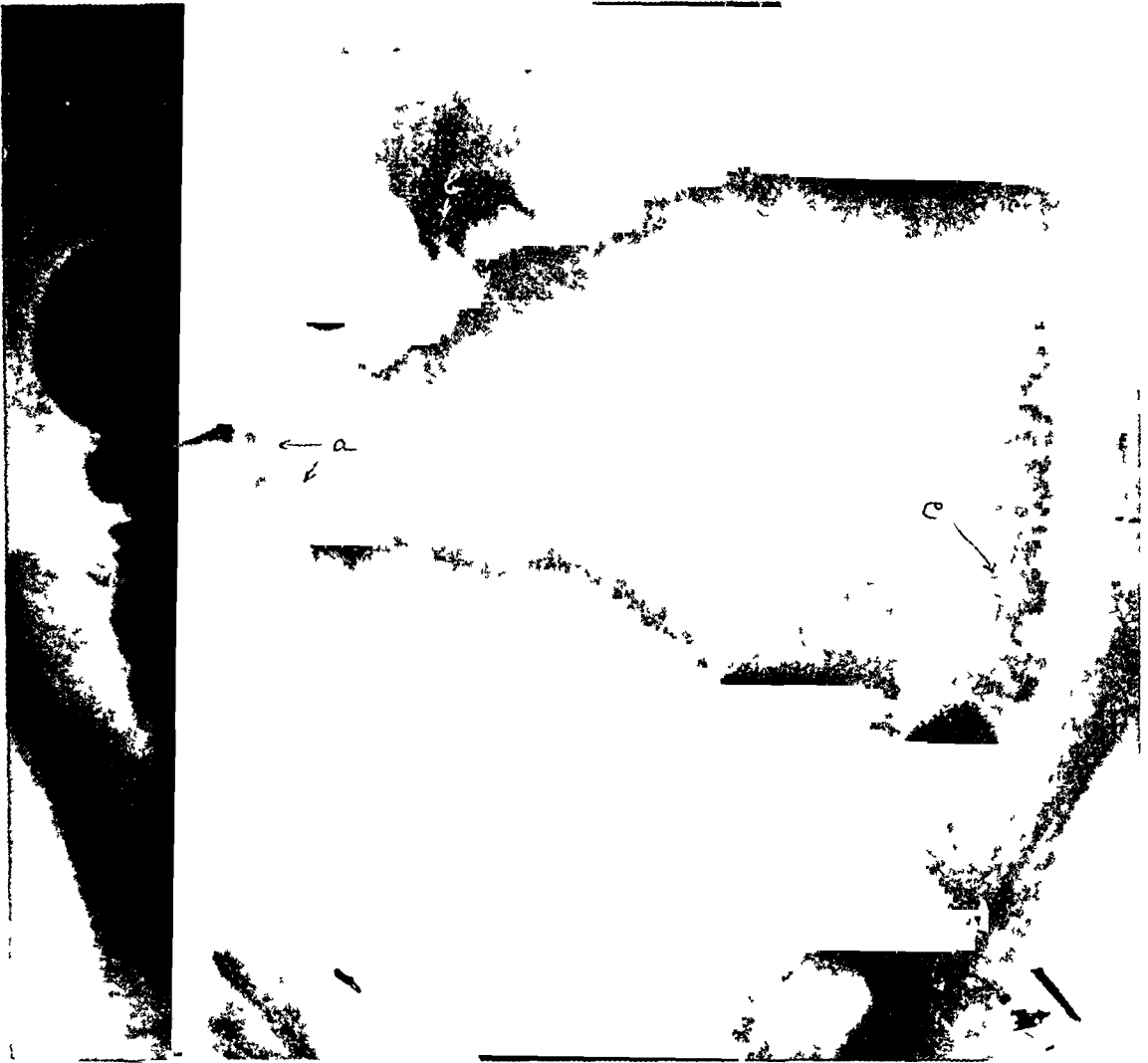


FIG 7—Diverticulitis of cecum (a), transverse colon (b) sigmoid (c) Acute abscess formation around cecal diverticula

Mrs T, aged fifty-six years, seen with Dr R C Brown and Dr W C Danforth Patient had had an irritable bowel for several years, the present illness started with a chill, high fever, and pain in the lower left abdomen toward the flank In the succeeding ten days a mass developed just above the brim of the pelvis on the left side A temperature of 101° to 102° F, and a leucocytosis was present The urine was negative By fluoroscopy the mass lay behind the sigmoid and apparently contained gas An incision in the flank encountered foul pus, retroperitoneally just behind the sigmoid The kidney was not exposed While it could not be proven, the probability was that the abscess resulted from a diverticulitis

CASE III *Long-standing sigmoidovesical fistula*—Mr R, aged sixty-nine years, seen with Dr H R Kretschmer History of passage of gas and feces with urine for

twenty-five years Cloudy urine, frequency, nocturia, occasional chills and fever for three years, occasional blood in the stools Onset twenty-five years ago with a perirectal abscess, which finally ruptured spontaneously At that time he passed pus in the urine and ever since has passed some gas in the urine Cystoscopy by Doctor Kretschmer showed feces in the urine, and an opening in the upper left quadrant of the bladder was present, which seemed to connect with the bowel Fluoroscopy of the colon showed multiple diverticula and a filling defect one inch long in the lower sigmoid loop (Fig 2) In the descending colon and splenic flexure there were multiple diverticula Because of the age of the patient, the long-standing fistula, the lack of progressive symptoms, and the probability of the necessity of resection of the bowel due to stenosis (Fig 1), he was advised to postpone operative treatment

CASE IV *Long-standing sigmoidovesical fistula from carcinoma of the rectosigmoid, which very closely resembled diverticulitis*—Mr R, aged fifty-nine years, seen with Dr H L Kreschner History of increasing constipation, necessitating cathartics, flatulence and cramp-like pains in the lower abdomen has been present for three months Pain in the suprapubic region had been present for two weeks No blood had been noticed in the stools and there were no urinary symptoms Examination revealed gurgling noises in the colon, tenderness and muscle spasm over the suprapubic region Rectal examination revealed a mass in the cul de sac outside of the rectum The prostate was normal to palpation Cystoscopic examination by Doctor Kretschmer showed a protrusion into the bladder from the outside

October 1, 1926—Operation by Doctor Kretschmer Midline incision, peritoneum opened for exploration showed large bowel firmly adherent to posterior bladder wall Peritoneum closed, cystotomy done A red, swollen area about 6 centimetres in diameter over the area of protrusion into the bladder was found Pressure made on the mass protruding into the bladder resulted in foul pus being expressed from an area about the size of a pinhead in the bladder mucosa I was asked to see the patient during the operation and at that time both K and D thought the condition was due to a rupture of a diverticulitis into the bladder Suprapubic drainage was instituted

October 4, 1926—Rectal examination showed mass in cul de sac nearly gone

October 11, 1926—Bowels moving, abdomen soft Above the prostate the finger can just touch a rounded mass

November 16, 1926—Gas is being passed through the urethra Patient runs a low-grade temperature Suprapubic opening closing Patient went home

February 1, 1927—Patient returned, with burning urination and passage of gas and feces in the urine Blood clots were present in the urine Running a low-grade temperature and losing weight The mass in the cul de sac is harder and larger Fluoroscopy of the colon shows a filling defect in the rectosigmoid, and sodium iodid placed in the bladder runs into the bowel We began to doubt the diagnosis of diverticulitis and think more of carcinoma

March 16, 1927—Because of infection of urinary tract a colostomy was performed under local anæsthesia A hard mass was felt in the pelvis

May 16, 1927—Patient died Anatomical diagnosis, carcinoma of the rectosigmoid Suppurative carcinomatous infiltration of the pouch of Douglas and the wall of the urinary bladder Fistulous tract between the rectosigmoid and the urinary bladder

CASE V *Tuberculosis of the bladder and peritoneum and a sigmoidovesical fistula*—Mrs E, aged fifty-six years, seen with Dr H L Kretschmer Entered the hospital March 21, 1924, with a history of six years duration of cystitis, associated with some discomfort in the lumbar region Cystoscopy by Doctor Kretschmer, showed an ulcer of the bladder the size of half a dollar Biopsy revealed tuberculosis The ulcer was then excised

August 25, 1925—Returned with cystitis and blood in the urine, in the dome of the bladder was a large white ulcer with a necrotic base This area was dissected by Dr K Pathological diagnosis, tuberculosis

SIGMOIDOVESICAL FISTULÆ

November 16, 1925—Patient nauseated and vomiting

February 13, 1926—Feces and gas discharged from bladder through the cystostomy wound

April 22, 1926—Colostomy advised by D to sidetrack fecal stream Left rectus incision revealed peritoneal cavity obliterated by firm, fibrous adhesions The large bowel could not be identified A right muscle splitting incision, cecostomy was performed

June 5, 1926—Patient died Anatomical diagnosis, tuberculosis of the left kidney Extensive pelvic tuberculous peritonitis Fistula between urinary bladder and sigmoid Ascending pyelonephritis

CASE VI *Sigmoidovesical fistula*—Mr X, aged fifty years History of cramp-like pains and gas formation in the lower abdomen over a period of several months Two weeks before entrance to the hospital acute abdominal pain with fever, followed by passage of gas and feces into the bladder Cystoscopy showed a small opening in a diverticulum of the bladder, from which gas escaped Colostomy performed by Doctor Bevan Subsequent laparotomy with separation of the bowel and bladder

CASE VII *Sigmoidovesical fistula from diverticulitis Abscess in right hypochondrium from diverticulitis*—Dr J K, aged forty-five years, seen with Dr H L Kretschmer Present complaint, passage of gas and feces in the urine, with symptoms of cystitis This condition began six weeks before entrance to the hospital (November 24 1925), and followed an attack of constipation at which time he took a cathartic and an enema, which resulted in marked abdominal cramps and several stools The passage of gas and feces in the urine continuing, the patient had several examinations at various clinics, where various diagnoses were made At one clinic a piece of tissue from the region of the fistula in the bladder was excised through a cystoscope, and a diagnosis of papillary carcinoma of the bladder was made Cystoscopy by Doctor Kretschmer showed an œdematous bladder mucosa, and at the base of the bladder behind a median bar, in an area of œdema and inflammation, a dark opening was seen which looked like a fistulous opening A piece of tissue excised from this region showed chronic inflammation Following biopsy the patient had bloody urine and bladder pain, followed by the development of a mass in the suprapubic region, accompanied by fever of 101° to 103° F for about ten days During this time we were on the verge of performing a colostomy, but at the patient's urgent request we refrained The symptoms gradually subsided and the mass decreased in size, but has persisted until the present time Proctoscopic examination was negative, a fluoroscopic examination of the colon showed multiple diverticulitis of the sigmoid and transverse colon (Fig 3) Although the sigmoidovesical fistula was still present, the patient left the hospital, but returned August 21, 1926 with pain in the upper right abdomen and a palpable mass just below the costal arch This mass increased in size and was accompanied by fever An abscess was diagnosed, and under gas September 1, 1926 an incision was made over it and pus was encountered under the fascia of the external oblique The pus was found to exude through an opening in the muscle which entered the abdomen This abscess was undoubtedly due to a diverticulitis in the transverse colon At the last examination the fistulous tract into the bladder still persisted, and the patient was advised to have a laparotomy for its repair, which up to the present date he has refused to have

CASE VIII *Sigmoidovesical fistula from diverticulitis of the colon*—Mr B, aged fifty-six years, entered Cook County Hospital June 14, 1928, with a history that eight years before he had symptoms of cystitis and passed blood and feces in the bladder urine These symptoms persisted and five years ago were complicated by a mass which developed in the left lower quadrant, varied in size for about a year, until it was opened when a large amount of pus and feces escaped A fecal fistula has persisted In addition to gas and feces in the urine, the patient has noticed that he passes urine with the feces Cystoscopic examination revealed a markedly inflamed bladder containing three bladder stones, and turbid, fecal-smelling urine (Fig 4) The opening of the fistula could not be seen X-ray examination of the colon was unsatisfactory (Fig 5), due to the fact

that the patient could not retain the enema, and obstruction seemed to be present in the sigmoid. No diverticula were seen. On July 9, 1928, I opened the abdomen through a mid-line incision and found a markedly chronic, pelvic adhesive peritonitis uniting the large bowel to the base of the bladder. The adhesions were separated, the left ureter was identified, and the sigmoidovesical attachment was found to be one inch above the left ureterovesical junction. The bowel and the bladder were separated and a three-layer inverting suture was placed in both viscera. The laparotomy wound was then closed with a small iodoform gauze wick in a split tube reaching down to the depth of the peritoneal cul de sac. The bladder was then opened, the three stones removed, and a permanent cystotomy performed. The operation lasted one and a half hours, and the patient left the operating room in good condition. He did well for three days, when he suddenly developed a bilateral bronchopneumonia and died in thirty-six hours. There was no urinary or fecal discharge from the abdominal wound, and the abdomen remained soft.

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ACUTE PERFORATED ULCERS OF THE STOMACH AND DUODENUM *

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FROM THE SECOND SURGICAL DIVISION OF THE NEW YORK HOSPITAL

HEREWITH are recorded 142 cases of Acute Perforated Ulcers of the Stomach and Duodenum operated on by Doctor Pool, or his associates, at the New York Hospital. In *ANNALS OF SURGERY*, October, 1922, fifty-nine cases were reported by the author of this article in conjunction with Doctor Pool, and these patients are included in this tabulation with the records brought up to date. A statistical report is given, the mortality analyzed, and the follow-up results noted in detail. The literature has been investigated and an effort made to furnish some data that might serve as an aid in the cure of this dangerous lesion.

As one reads the reports from various clinics and peruses the voluminous pages of statistics, one is apt to attempt a classification, to evolve a standard. An attempt is made to have a set procedure for a given pathological lesion. But herein lies the fallacy—the lesion is not a standard condition, but one occurring in a human being, and the process is a relative one. There is nothing absolute, but with a thorough notion of the possibilities one is more apt to have the proper method to apply to the given case. And so the discussion goes on, and some clinics are wed to simple suture of perforations while others feel that the primary gastroenterostomy is necessary. In this difference of opinion it is evident from the records that early diagnosis plus immediate operation means low mortality in spite of the procedure. Study the mortality records of any clinic and it is found that the death rate is directly dependent on the time elapsed from the perforation to the time of operation. For a long time the much mooted question has been simple closure *versus* closure plus primary gastroenterostomy. Again let it be emphasized that both procedures yield low mortality where the operation is performed under six hours.

In this series of 142 patients there were 138 males and 4 females, with a mortality of not quite 22 per cent. In analyzing the cases that died it was found that the most important factor was the time elapsing between the perforation and the operation.

Under six hours there were 94 cases with 7 deaths, or a percentage of 7 $\frac{21}{47}$ per cent. Between six and twenty-two hours there were 32 cases with 11 deaths, a rate of 31 $\frac{1}{4}$ per cent. Over twenty-two hours, there were 16 patients with 13 deaths, a percentage of 81 $\frac{1}{4}$ per cent.

As to the cause of death, 24 died of general peritonitis, 5 died of pneumonia, 1 of pulmonary embolus, 1 of multiple abscesses of the liver. It was noted that of those who perforated after eating, those who had been given

* Read before the New York Surgical Society, October 9 1929. See page 1077

brisk purgatives immediately after perforating were more apt to have a larger extravasation of gastric contents into the peritoneal cavity and a more fulminating peritonitis with graver complications and more unfortunate results. This again suggests that one beware of cathartics in acute abdominal conditions. Those who perforated with an empty stomach had very little escape of fluid and the prognosis was more favorable. To combat this 22 per cent mortality in the series three things might be suggested 1, Early diagnosis, 2, Nothing by mouth, 3, Early operation.

The next important cause of death was from pneumonia. Five patients died of pneumonia. This condition has been the cause of many deaths in simple, uncomplicated conditions—as a pneumonia following a simple appendectomy or a herniotomy—and a considerable amount of study and investigation has been done with the idea of determining the primary etiological factor and eventually eradicating pneumonia from the list of complications. On the Second Surgical Division there has existed a pneumonia prophylaxis committee for a good many years and the function of this committee has been to investigate this disease from every angle. The type of patient, his home surroundings, his normal habitat and routine, his daily garments, his sleeping apparel, the ventilation of the ward, the avoidance of drafts, the bacterial examination of the buccal contents, the sera preventative therapy, the care of the patient in transportation, the type of anæsthesia, the proper coverings—these and other factors were considered and an effort has been made to see that the patients experience as little change of environment or dress as possible. After operation those developing colds were carefully studied, chest X-rays, sputum, cultures, etc., in an attempt to lower the incidence of pneumonia. With all these aids it was also found that with the introduction of ethylene anæsthesia there was a marked reduction of the pulmonary complications.

In a study of the gastric cases it was found that the pulmonary complications were higher than in lower abdominal surgery. In the last 32 cases in this series there were 13 pneumonias with three deaths. It is interesting to note that two of the most recent perforations have been done under spinal anæsthesia, one of the patients developing a post-operative pneumonia, the other an abscess of the wound. There was one pulmonary abscess in the series, and one case developed multiple abscesses of the liver.

Attempting to associate the disease with certain definite factors it was found that the season of the year had little influence on the disease. The youngest in the series was eighteen years, the oldest sixty-nine years. Men perforated much more frequently than women. Race, color, creed, all alike were visited by the affliction and neither rich nor poor were spared.

Naturally, in a study of this kind an effort was made to discover the causative factor—an ulcer, a lesion in which the processes of degeneration are slightly in excess of those of regeneration. As in most ulcers the cause may be local, as from trauma, chemical insult, thermal affront or bacterial invasion. The cause may be general as in some constitutional disease but, most prob-

ably, it is the combination of both a constitutional disorder plus a local condition. The more one sees of this disease and the more one studies these patients, the more one is impressed with the associated nerve involvement in these ulcer cases. Patients well and free of symptoms for weeks, months and years have some sudden nervous upset—a financial loss or some family worry—and the symptoms recur, severe pylorospasm, excessive gastric secretion, gastric heaviness, uneasiness, discomfort and pain. Turn these patients out into the country, relieve their anxieties and many of them are relatively well again.

The majority of these patients gave a history of gastric distress for some months or years prior to operation, while others were certain the initial symptom was the perforation. In talking to these patients the alcoholic history was most carefully considered and it was ascertained that most of them were not alcoholic in habit.

The history of acute agonizing pain with a restless patient tossing from side to side, with knees and thighs flexed, breathing short costal breaths and appearing seriously sick clinches the diagnosis. The patient looks like a wounded animal and the initial picture is of inhibition, of a person trying to protect himself. Subnormal temperature, slow pulse, costal breathing, low leucocytes, a picture of holding everything—inhibition. This is the time to diagnose, the time to operate. The subsequent picture is generally one of peritonitis.

Procedure—In less than an hour after admission most of these patients were operated on, ethylene-ether being the anæsthesia of choice. A high right rectus incision and a simple closure of the ulcer with drainage to the peritoneum. In 10 of the 142 cases a primary gastroenterostomy was done because the operator felt the lumen of the pylorus had been obstructed. Two of the cases re-perforated and had a gastroenterostomy at the second procedure. None of the cases with primary gastroenterostomy died. After operation the patients are placed in bed and the following instructions serve as a guide for the routine care. However, it must be definitely understood that each case is different and must be treated as such. The diet is but a guide.

First Post-operative Day—Water, 1 dram every half hour.

Second Day—Water, $\frac{1}{2}$ ounce every two hours alternating with peptonized milk, $\frac{1}{2}$ ounce every two hours.

Third Day—Water, 2 ounces every two hours alternating with peptonized milk, 2 ounces every two hours.

Fourth Day—Water, 4 ounces every two hours alternating with milk, 4 ounces every two hours.

Fifth Day—Water, 4 ounces every two hours alternating with milk or egg nog, 1 ounce every two hours.

Sixth Day—BREAKFAST Cereal with cream and small amount of sugar. One cup cocoa. TEN A M Egg nog. DINNER Cream soup, soft boiled egg with softened toast. THREE P M Egg nog or milk. SUPPER Milk toast, custard. EIGHT P M Cocoa or milk.

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Seventh Day—BREAKFAST Cereal with cream and sugar One cup cocoa TEN
A M Egg nog DINNER Cream soup, baked potato with butter, milk, 6 ounces Two
P M Milk or egg nog SUPPER Milk toast or soft boiled egg, custard EIGHT P M
Cocoa or milk

Eighth Day—BREAKFAST Cereal with cream and sugar, one soft boiled egg, one
slice toast, cocoa or milk TEN A M Egg nog DINNER Cream soup, baked potato
with butter, custard, milk TWO P M Egg nog SUPPER Milk toast or oyster stew,
milk, wine jelly and cream EIGHT P M Cocoa or milk

Ninth Day—BREAKFAST Cereal with cream and sugar, one soft cooked egg, one
slice toast, cocoa or milk TEN A M Egg nog DINNER Cream soup, baked potato
with soft cooked egg, wine jelly with cream, milk or cocoa SUPPER Milk toast, custard,
cocoa EIGHT P M Egg nog or milk

Tenth Day—BREAKFAST SIX prunes, cereal with cream and sugar, one soft cooked
egg, cocoa TEN A M Egg nog DINNER Cream soup, scraped beef on toast, custard,
milk TWO P M Egg nog SUPPER White meat of chicken, toast, wine jelly, milk
EIGHT P M Cocoa or milk

Eleventh Day—Add green vegetables

Primary gastroenterostomy was done in 11 cases and secondarily in 10 cases, or 21 in all

Follow-up—One hundred and eleven patients were discharged after operation and 103, or 92 88/111 per cent, have been followed These patients are never discharged from the follow-up clinic and are seen quite frequently as symptoms warrant by one man who makes a particular study of these cases, carefully analyzes the symptoms, advises as to diet, etc Most of these patients have been fluoroscoped since operation and many X-rays taken to study the post-operative condition The post-operative picture generally shows a slight distortion at the site of perforation In seeing these patients, in painstakingly listening to their stories one cannot but be impressed with the important part the nervous system plays in this disorder A patient is well, free of symptoms, gaining in weight Some misfortune occurs, the patient is upset, and the gastric story begins again Uncomfortable heavy feeling in the epigastrium, inability to concentrate, restlessness, yawning, these are the signs and the patient consults the doctor Fluoroscope this patient and a marked pylorospasm is found and, in some cases, it lasts from two to three days Relieve the nervous condition, set the patient aright, the pylorospasm yields and hypermotility recurs because it has been found on examination that these patients have hypermotile rather than hypomotile gastrointestinal tracts The condition disappears and the patient is well for months, for years It may be the only attack Fluoroscope this patient a week after the attack and a normal stomach and duodenum is observed, with no spasm, no retention This suggests definitely that in the recurrence of symptoms one should not be too ready to operate Give them a chance An effort has been made to get close to these patients, win their confidence and let them feel that one is anxious to help With this notion in mind a short talk is given to each patient before leaving the hospital

In these stomach cases the question of post-operative therapy is paramount and, while the etiological factor in the production of ulcers has not been

determined, it is known that they are generally associated with an increase in the acid content, notably an increase in free HCl. The nervous, high-strung individual facing a crisis, going through some unusual mental effort is generally the ulcer type that perforates. Whether the etiological factor be bacteriological, parasitic, embolic, chemical, thermal or mechanical, the thing to be remembered is that most of these patients have an increased acid content with hypermotility of the stomach and the intestines, there is a constitutional plus a local cause. The pain and discomfort are due to increased acid plus tension. The constant nerve reflex from the stomach causes increased activity of the smooth muscle with tightening of the pyloric sphincter and constant effort on the part of the stomach to drive its contents on causes the severe pain and spasm at the pylorus. It is a question of tension. These patients are not as a rule constipated but, if anything, hyper-active. The peristalsis is increased, not diminished, and it is this constant nerve stimulation that causes the pylorospasm, shutting down of the pylorus and the accumulation of acid with subsequent gastric fermentation that causes distress. The gas accumulates, the stomach dilates, the tension is increased and the patient resorts to all sorts of charged water, vichy, etc., to try to "belch." Belching gives great relief. Here then is the crux of the whole situation. The enumeration of cases, the careful steps in technic, can all be standardized but the important thing is that each case is an entirely different clinical entity and must be treated as such. The large atonic stomach in the nervous, sensitive individual is the condition to be treated. Therapy—as the etiological factors are probably (1) constitutional and (2) local so the treatment must be (1) constitutional and (2) local.

Take the nervous, high-strung individual, turn him out to grass, remove his worries, solve his economic difficulties and an excellent start has been made. Many of these stomach cases are perfectly well for a long period but as soon as they lose their mental poise, some accident, some shock, down they go and the trouble begins. Fluoroscope this patient and one finds the severe pylorospasm, hypermotility, increased tension. Mental rest, careful coaching and they are well again almost immediately and the symptoms are gone for years, maybe forever. In the study of these cases here is where the progress has been made. Each patient before he or she leaves the hospital is given careful instructions as to hygiene and to diet. Not a mere form without reasons, but a list is given and intelligently discussed. The talk would go as follows:

"You have had a severe condition, an ulcer of the stomach and it means you must be always careful as to your habits, diet and exercise. It is most important for you to keep in contact with some intelligent physician to advise and coach you. That is what you want, a coach, not necessarily a doctor. Someone to whom you can talk, discuss your troubles. No one knows definitely what causes ulcers but they generally are found with an increase in acid. The stomach is large, becomes filled with food that decomposes and then gas is formed. Be very careful in taking your food, wash

the hands and rinse the mouth to get rid of all bacteria. Take time to eat, sit down and chew the food, remembering that the food should be broken up in the mouth, mixed with the salivary juices and prepared for entering the stomach, so that the food does not drop in the stomach as a lump of lead. Try not to mix liquids and solids nor take a large amount of water at the meals as they just fill up the stomach and make it atonic. This is the cardinal principle. *Never* have the stomach 'empty'. *Never* have the stomach 'filled'. This means frequent small meals a day throughout the day. Eat at two- to three-hour intervals. The need of frequent feeding is quite evident in treating gastric cases. They acquire a dread of food, lose weight and resistance.

"On arising, if possible, drink a glass of warm milk to counteract the acid that may have accumulated during the night."

AT 8 00 A M BREAKFAST—*Simple plain foods*

A Any kind of stewed or cooked fruits. Avoid oranges, grapefruit or any raw fruits.

B Cereal with milk or cream, gruel, oatmeal, cornflakes, bran, puffed rice, shredded wheat.

C Eggs—poached, boiled, scrambled. Not fried.

D Toast or rolls with butter.

E Coffee, one cup.

Drink no water with meals.

TEN A M—Glass of milk with a cracker or piece of bread.

Just about this time most of these patients begin to feel empty in their stomachs, they have no pain, but are conscious of their stomach, begin to yawn and to get quite restless. It is amazing how a small amount of food puts them right back on their feet. For a long while milk alone was advised or soda bicarb but neither stays long enough in the stomach. The addition of some small solid matter means the food stays longer and acts like a soothing dressing to a weeping stomach. "Drink small amounts of water at a time between meals."

NOON—A Soup—chicken or cream soups only, as the beef extractives, consomme, etc., tend to stimulate gastric secretion.

B Fish—almost any fish.

C Entrees—steaks, not well done, roast beef, pot roast, lamb chops, chicken, veal—small amounts. Foods fried in grease should be avoided.

D Potatoes—boiled, mashed, baked. Not fried.

E Vegetables—spinach, string beans, beets, peas, cauliflower, asparagus. Avoid onions.

F Dessert—custard, puddings, ice cream, small piece of plain cake.

One cup of tea.

Drink water in small amounts between meals.

THREE-THIRTY P M—Milk and crackers.

SEVEN P M DINNER—Meat, bread and butter, potatoes, vegetables, one cup of coffee.

NINE-THIRTY P M—Milk and crackers.

This gives a wide latitude and from observing each case one finds that certain things are good for A and bad for B, and *vice versa*. That is the

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idea of the doctor or coach to check up on the diet list Alkalies should be encouraged at all times Alcohol prohibited

Food fried in grease forms a bolus that slips into the stomach It is hard for the gastric juices to penetrate this bolus and the food lies there, a heavy undigested mass

If the patient awakes at night and has any discomfort, take either a glass of milk, if accessible, or soda bicarb in water

The teeth should be put in perfect condition and a dentist seen at least every six months

When possible, rest for fifteen minutes to one-half hour after eating Have bowels move freely Never eat when nervous or excited

This routine of coaching, advising, helping the patients has done much to make the results in gastric surgery much more satisfactory

ONE-HUNDRED AND FORTY-TWO CASES OF ACUTE PERFORATED ULCERS TABULATED STATEMENT

Cases	142
Deaths (31 59/71 per cent)	
G P	24
Pneumonia	5
Pul Embolus	1
Mult Abscess Liver	1
	— 31
Color—Negroes	3
Sex	
Male	138
Female	4
Mortality	
94 cases under 6 hours—deaths (7 21/47 per cent)	3
32 cases between 6 and 22 hours—deaths (32 1/4 per cent)	11
16 cases over 22 hours—deaths (81 1/4 per cent)	13
Primary Gastroenterostomy—6 3/71 per cent (average time 3 3/4 hours perforation)	10
Primary Pyloroplasty	1
Secondary Gastroenterostomy	10
Follow-Up	
Discharged	111
Followed	103
Results	
Well without symptoms since operation	
Without Primary Gastroenterostomy	77
With Primary Gastroenterostomy	5
With Pyloroplasty	1
	— 83

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Had return of symptoms	
Without Primary Gastroenterostomy (10 had Secondary Gastroenterostomy)	18
With Primary Gastroenterostomy	2
	— 20

SUMMARY

Without Primary Gastroenterostomy	
Good (81 2/19 per cent)	77
Poor (18 18/19 per cent)	18
	— 95

With Primary Gastroenterostomy	
Good (71 per cent)	5
Poor (29 per cent)	2
	— 7

With Pyloroplasty	
Good	1
	—

TOTAL CASES FOLLOWED	103
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Simple closure has given good results in a fairly high percentage of cases Dr Luis Urrutia, of Madrid, Spain, reporting "Late Results in Perforated Gastro-duodenal Ulcers" in the ANNALS OF SURGERY for July, 1929 (page 73), has extensively referred to the bibliography of this condition and discusses simple closure *versus* closure plus primary gastroenterostomy His own predilection is for simple closure At the New York Hospital on the Second Surgical Division simple closure is the method of choice—(1) because there is less risk and (2) because 20 per cent of all gastroenterostomies done on the division have yielded untoward results Hence the tendency has been to shun gastroenterostomy where possible

This series represents many cases followed over a long period The longest twenty-one years It emphasizes the following salient points

- 1 Early diagnosis with operation under 6 hours yields low mortality
- 2 Pulmonary complications are a serious factor in this condition accounting for 16 per cent of the mortality
- 3 Post-operative diet and medical coaching are essential for a long time after operation
- 4 Secondary operations should be performed only after a most careful study of the case and a prolonged course of medical treatment
- 5 Secondary gastroenterostomy has given excellent results to those requiring further surgery

THE PHYSIOLOGY OF THE LIVER AND ITS RELATION TO SURGERY OF THE BILIARY TRACT*

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ADVANCES in surgery of the liver, and particularly of the extrahepatic biliary passages, during the last few years have provided new bases for rational treatment of diseases of these organs. As in surgery of the genito-urinary tract particularly, and as in surgery of the thyroid gland, new methods of estimating functional capacity and pathologic injury to the liver and its appendages have made for safer operations with better insight into the risk of operation and the chance of permanent or partial cure. Most significant of all, perhaps, newer methods combined with clinical factors have made for better selection of the time of operation which provides the safest and most expedient avenue for recovery. The last ten years have witnessed the development of most of the important newer facts concerning the physiology of the liver and its adnexa so far as their functions are related to surgery of these organs.

Any study of the liver is complex. Anatomically the liver is of special interest in surgery because it is a single vital organ and because it has a double blood supply. Physiologically it is important because of the multiplicity of its metabolic functions. Pathologically it is important because it is subject to many diseases of infectious, vascular, metabolic and neoplastic origin. Surgically it is important for all of these reasons.

PHYSIOLOGY

Regenerative Function of the Liver —For many years it has been known that the liver regenerates rapidly after serious injury following chloroform poisoning. Mann has noted similar regenerative phenomena after surgical removal of lobes of the liver. One lobe may be removed and after a few weeks the liver will be as large as before the operation. Consecutive operations for removal of other lobes are followed by similar replacement of tissue. The lobes are not restored, but the remaining lobes increase in size and their edges become rounded. The remaining tissue appears to function normally although it is not able to withstand untoward conditions as well as is normal hepatic tissue. The regenerative tendency may be prevented by experimental short circuit of the portal circulation before lobectomy, by occurrence of biliary obstruction, and by cirrhosis. In this manner the total hepatic tissue may be permanently reduced to as low as 15 per cent of the normal amount.

* The Trimble lecture given before the Medical and Chirurgical Faculty of the State of Maryland, April 24, 1927.

† Some of the work of preparation of this paper was done by C. Baxter Brown, M D, Fellow in Surgery, The Mayo Foundation, Rochester, Minnesota.

Under these circumstances the liver appears to function normally if the animal is kept on a carbohydrate diet composed largely of milk and syrup. If proteins are fed, such as in the form of meat, cirrhosis with ascites develops and the animals die.

These facts are emphasized clinically by the known ability of the liver to perform adequately all its functions even in the most marked degrees of disability due to disease which may be either primary or secondary to lesions in the extrahepatic bile passages. It is known clinically and experimentally that the great metabolic functions of the liver are adequately performed when the liver is most seriously handicapped either by disease or experimental surgical destruction of its tissue.

Carbohydrate Metabolism—Since Claude Bernard called attention to the liver as a storehouse for carbohydrates, our knowledge of this hepatic function has increased. It is known that glucose resulting from intestinal digestion reaches the liver through the portal circulation where it is in part utilized immediately for bodily consumption and is in part stored as the readily accessible compound glycogen. With any need for glucose, glycogen is hydrolyzed and converted to glucose. Although glycogen is not wholly stored in the liver and comprises a considerable percentage of muscle constituents, the principal storehouse is in the liver. Mann⁴ has shown definitely the rôle of the liver in carbohydrate metabolism, by experimental surgical hepatectomy and exhaustive studies of blood-sugar levels under various conditions. Following experimental total removal of the liver, there is progressive hypoglycemia which increases to a point at which definite symptoms appear, followed by convulsions and death. The blood sugar may be restored and the symptoms completely relieved by the intravenous administration of glucose over a period of many hours, when another and different set of symptoms appears, followed by death from another cause. The rôle of the liver in the maintenance of blood-sugar levels is therefore necessary to life. Other substances such as lactic acid and levulose when administered intravenously, do not cause a rise in blood sugar nor do they defer death as does glucose. During the periods of hypoglycemia, muscle glycogen is measurably reduced, but even at death the amount is sufficient, were it mobilized, to maintain normal blood sugar, thus showing that the synthesis of glucose is dependent wholly on the liver. In cases of depancreatized dogs manifesting hyperglycemia, dehepatization has a similar effect on the blood-sugar level and the clinical course.

Clinical measurement of the carbohydrate metabolism of the liver has been variously made by many workers, the most popular of these methods, the levulose tolerance test, is based on the known fact that in hepatic disease the tolerance to levulose following intravenous administration is measurably reduced. The appearance of levulose in the urine may be taken as a rough measure of injured hepatic function. With newer and finer methods of blood-sugar estimation more satisfactory results are obtained. Clinically, the test is said to have some practical significance. Mann has shown experimentally, however, that the test is not as reliable as the simple glucose test, and, further-

more, that glucose tolerance tests are not reliable indices of the amount of disease because of the intervention of uncontrolled factors which affect the rate of disappearance of glucose from the blood stream, namely, injury to the pancreas and fasting

It is evident that the function of the liver in respect to the metabolism of glucose is not shared by other organs and that the necessity of the liver in carbohydrate metabolism is demonstrated. Clinically, however, the methods of demonstrating hepatic injury in respect to the utilization of sugar are so unreliable as to point to the deduction that such injury affects only the reserve capacity of the organ. For this reason, along with the fact that other organs notably the pancreas, play so important a part in the metabolism of glucose, helpful methods have not been developed for the clinical study of this function in hepatic disease. No doubt, part of this failure may be ascribed to the fact that other methods are available for estimating hepatic injury, which are satisfactory for clinical purposes.

Protein Metabolism—In a general way it is known that proteins are digested in the intestinal tract to form amino acids which are converted into urea in the liver, and that the urea in turn is excreted in the urine. The measurement of hepatic disease in respect to these processes has not progressed to the point at which accurate and helpful determinations may be made, but from the standpoint of experimental physiology a great deal is known. Bollman and Mann,¹⁻³ in a series of experiments with dehepatized dogs, have shown that following removal of the liver the amount of urea in the blood and urine is markedly decreased, and that the amount of amino acids in these fluids is increased. Furthermore, amino acids injected intravenously may be recovered quantitatively from the blood and urine. This shows definitely that deamidization and urea synthesis in the liver are not shared measurably by any other organ, and it may be deduced that, although a good clinical method is not available for the accurate estimation of the injury to protein metabolic processes in hepatic disease, still the significance of the factor in surgical procedures must be considerable. Walters and Parham¹⁷ have shown that following operation on jaundiced patients, hepatic insufficiency associated with abundant drainage of light-colored bile may be the cause of death. In this syndrome marked changes in the urine or blood related to protein metabolism are not present. However, in similar cases there is renal insufficiency secondary to the cessation of drainage of bile in which the level of blood urea rises progressively to the point of uremia. In these cases it is understood that the increases in urea are not due to any abnormality in hepatic function but to distinct renal insufficiency of toxic origin in which there are definite post-mortem manifestations of the lesions of nephritis. Even when hepatic injury is sufficient to be fatal, enough urea is formed in the liver, so that blood urea is maintained at a normal level. When renal insufficiency is present, the level of blood urea will be raised to that found in uremia. It is evident that the part of the liver in the metabolism of proteins is important and that the liver is probably the sole site of the formation of urea. On the other hand,

the liver is so sufficient for this process that a small portion of it is apparently capable of caring for protein metabolism. At least this is apparent so far as modern laboratory methods are able to demonstrate. It is probably true, then, that any clinical method of measuring hepatic injury from the standpoint of the metabolism of protein will have little value in surgery, but will remain of purely physiologic interest.

It has been suggested by Mann⁵ that the measurement of uric acid in the urine at times when patients are on a high purin diet may provide a means of estimating hepatic insufficiency from the standpoint of the protein. This suggestion is based on the fact that after experimental dehepatization, the ability to destroy uric acid is absent, in consequence, relatively large amounts of uric acid are excreted in the urine, and simultaneously the level of uric acid in the blood is increased.²

Bile Metabolism—The significant constituents of bile are the acids, the pigments, and cholesterol. The bile acids, glycocholic and taurocholic, are intimately associated with the digestion and absorption of fats from the intestine. There are no practical methods for estimating the bile acids for clinical purposes, although the Pettenkofer reaction has been employed variously. The absence of the acids in the intestine, as in obstruction to the bile ducts, is the cause of fatty stools, fatty stools serve as a rough qualitative test of the absence of acids. Cholesterol is principally concerned with the formation of gall-stones, and they do not concern surgical procedures except so far as their presence or absence has a bearing on the case.

The metabolism of the bile pigments and their excretion are most important in biliary surgery. The source of bilirubin was a matter of controversy for many decades, until it was shown definitely by Mann and his associates,^{6 7 8 9} by means of the spectrophotometer, that this pigment is principally formed in the bone-marrow, and to a lesser extent in the spleen and liver. It seems probable that the tissues most likely to form bilirubin are those containing cells of the reticulo-endothelial system, since they are most numerous in the organs mentioned. There is also histologic evidence of their activity in this respect. Bilirubin, which represents only part of the excretion of the liver, provides the best means of estimating hepatic injury clinically, since this may be measured accurately and easily in the blood serum. The van den Bergh reaction is qualitatively and quantitatively accurate for the pigment in the blood. Duodenal drainage, after the manner perfected by Lyon and Meltzer, is a less accurate measure of pigment excretion, but in cases in which the obstruction is complete, the method is of some significance.

Coagulation Factors—Delayed coagulation with bleeding in clinical cases of hepatic disease and jaundice is a grave danger and a frequent cause of post-operative death. It has been shown experimentally by Whipple and Hurwitz¹⁸ that injury to the liver of dogs causes marked lowering of the fibrinogen level in plasma. Mann has corroborated this on liverless dogs. Clinically, in diseases of the liver plasma fibrinogen is lowered. Measurement of the coagulation time of the blood in jaundiced patients is a practical

method of estimating one of the elements of surgical risk. The calcium time adds little information since it runs practically parallel with the coagulation time.

Detoxification Property—The liver probably has other functions, including a detoxifying property which is presumed to protect the organism against bacterial invasion, against the toxins and against certain metallic poisons. There is little dependable, experimental or other proof to substantiate this contention, although certain phenomena point toward such a conclusion. The metallic poisons, for instance, and especially chloroform, when administered in suitable doses, cause focal necrosis of the cells of the liver without injury to other organs, indicating that the liver acts as a protective mechanism for the body. Priestley¹¹ has shown experimentally by using the heart-lung-liver preparation that the liver has a powerful detoxifying property for strychnine administered in the blood stream. His work shows that many times the lethal dose of this drug will be completely removed from the blood by perfusion through the liver. No accurate or dependable deduction may be drawn from this which is applicable to clinical medicine or surgery, but by inference it may be suspected that the liver has a powerful detoxifying action for other poisons, and possibly for bacteria and their toxins. The question arises whether hepatitis, as seen at the operating table, may not represent residuals of infectious or toxic poisons from which the liver has protected the organism at its own expense. In this respect the marked reserve of the liver is again emphasized, for remarkable degrees of hepatitis are found at operation in cases in which exploration is carried out for other and separate reasons and in which none of the clinical symptoms or findings could be attributed to hepatitis.

Hepatitis—For a long time we have known that the condition which we describe as hepatitis occurs not only in association with disease of the biliary tract but often when other trouble cannot be recognized. In spite of the fact that we have only rarely been able to isolate bacteria from the liver in these cases, it has been assumed that hepatitis was an inflammatory reaction in the liver, usually secondary to inflammation of the gall-bladder or biliary tract. Since we have come to realize just how important the liver is as a detoxifying agent, it has occurred to us that this tissue reaction in the liver which we designate as hepatitis may be the remains of the detoxifying process. Hepatitis, which is recognized by enlargement of the liver, showing white lines on the surface composed of fibrous tissue, is an extremely common condition. The hepatic tissue is more firm than normal, the edge of the liver is either very sharp, coming to a white fibrous line, or else rounded or cedematous. In operations for abdominal lesions, examination of the liver will disclose this condition more often than a normal condition of the liver.

We have recently completed a study of twenty cases which, at the time of operation, were classified as cases of primary hepatitis. We were unable to find any lesion in the abdomen other than the hepatitis. In seven of these cases typical gall-bladder colic was present, and in about half of the num-

bei mild jaundice was associated. In eleven of the twenty cases there was upper abdominal pain, which, however, was not colicky in nature, therefore, about half of these patients had had attacks of colic characteristic of disease of the gall-bladder with stones. It seems possible that the colicky pain in cases of gall-stones may be due to some process in the liver at the time of the attack. In these twenty cases, the gall-bladder showed very slight, if any, change. There were no stones, but in view of the fact that the clinical symptoms were those of the usual bile-tract disease, the gall-bladder was removed. As a result of this procedure, nine (56 per cent) of the patients stated that they were completely relieved of their symptoms. Six (37 per cent) were improved but not entirely relieved. One patient was but little improved, if at all. Four could not be traced.

At the time these twenty patients were operated on, we thought that the hepatitis was a part of an infectious process which involved the gall-bladder and bile ducts, and that our only approach to this infection was by the removal of the gall-bladder. It is not possible to determine just what changes resulted from the removal of the gall-bladder in these cases. It is not likely that the hepatic tissue was greatly changed. Removal of the gall-bladder would eventually overthrow the action of the sphincter at the end of the common bile-duct so that by some physiologic changes the symptoms might have been relieved.

Analysis of these twenty cases seemed to show that the detoxifying effect of the liver may be manifested by the condition which is referred to as hepatitis. If this is true, removal of the gall-bladder might bring about a change by producing changes in the physiology of the liver.

CLINICAL DATA—At the present time the methods at our disposal do not measure, in any case of hepatic injury, all of the hepatic function. For the clinical evaluation of the disease before operation, we are limited to and dependent on data that concern only a few of the important phases of the metabolism of the liver, namely, those of excretion of bile and coagulation of blood.

The dye retention test, as proposed by Rowntree, Hurwitz and Bloomfield,¹³ and as refined by Rosenthal,¹² is based on the fact that phenoltetrachlorophthalein is excreted only by the liver. The normal liver excretes all except 3 per cent of this drug from the blood stream in fifteen minutes to an hour after intravenous injection. By measuring the amount of dye present in the blood at intervals after its administration it is possible to evaluate the degree of retention by the liver in cases of disease which may be either primary or secondary to obstruction to the extrahepatic ducts.

The van den Bergh reaction is an application of the diazo reaction for pigment. It is quantitatively accurate for the amount of pigment due to bilirubin in the blood serum and, as far as we know now, is qualitatively correct. Two types of reaction occur, the direct and the indirect. The first occurring in obstructive and intrahepatic types of jaundice, is made by the direct addition of the reagent to the serum, the second which occurs in

hemolytic jaundice, requires the addition of alcohol. The variation in reaction is probably based on whether the pigment molecule has passed through the polygonal cells of the liver.¹⁰ Clinically the type of reaction and the degree of serum pigmentation are most important in the diagnosis of disease of the liver and its appendages. In selecting the type of operation in jaundiced patients, the serum bilirubin curve should be considered. Experience teaches that the most favorable time for operation is when the pigment has reached a more or less constant level in the blood, and not while it is fluctuating. It is of interest that degrees of jaundice of the skin apparently do not parallel those of the blood serum. This is especially noticeable in the fluctuating types in which the serum level increases more rapidly than the pigmentation of the skin, and subsides more rapidly. This teaches that clinical methods of estimating jaundice are important and that they should without doubt influence the surgeon within limits in choosing the time for, and the type of, operation.

Methods of cholecystography may be considered in part as Röntgen-ray adaptations of the dye method of measuring hepatic function, and they are undoubtedly of assistance in surgical problems, especially those related to the gall-bladder and ducts.

Readings of coagulation time should be made frequently before surgical intervention in jaundiced patients, preferably at regular intervals throughout the day for several days, since it is known that there are hourly variations in this factor. It is interesting that a parallel does not exist between the daily fluctuation in coagulation time and the serum bilirubin levels in any case, showing that these hepatic functions are attacked by disease in different degrees at the same time. This emphasizes again the complex nature of hepatic disease and the confusion that results from the efforts of internists and surgeons satisfactorily to fix in mind any reliable estimate of the disease as it appears at the operating table or at post-mortem examination. One is impressed with the fact that these various means of establishing the degree of hepatic injury are not complete or infallible and that they are hardly more than valuable adjuncts to the clinical data, the history and the general examination as interpreted in the light of experience.

The treatment of surgical degrees of hepatic disease is limited to the known methods of combating jaundice and increasing coagulation time. The best methods include the administration of calcium chloride intravenously on three successive days,¹⁶ the giving of blood transfusions and the intravenous infusion of glucose in 10 per cent concentration. Gum acacia suspension has been tried as a pre-operative method of increasing blood viscosity but with little, if any effect. The diet should be high in carbohydrate, the water intake should be from 3000 to 4000 cubic centimetres daily.

Decholin has been used in cases of serious injury to the liver to stimulate the flow of bile. Wakefield and Powelson¹⁷ have shown in clinical work, that decholin has a strong cholagogic action in that it will increase water excretion in bile by approximately twice the normal amount although

the excretion of bile pigment and bile acids remains quantitatively the same. In a recent case of suppurative cholangitis without stones and with severe injury to the liver, following T-tube drainage, for five days bile did not flow. After the administration of one gram of decholin on two consecutive days the drainage of bile amounted to 920 cubic centimetres on the third day.

PATHOGENESIS—Much progress has been made in the study of infection and undoubtedly certain of the conditions found in the hepatic system are the result of infectious processes. When one attempts to prove this, however, one meets with many surprises for it is frequently impossible to demonstrate bacteria of any kind in gall-bladders that are greatly changed as a result of disease. Some observers even go so far as to say that disease of the gall-bladder is never due to infection. Many different theories have been suggested all of which are difficult to prove, but it must be admitted that benign non-infectious disease frequently exists in the gall-bladder. On more than one occasion in the clinic, bacteriologic studies have been carried out on a series of gall-bladders removed at operation. The results have varied greatly. It was possible to obtain growth of organisms in only 50 per cent of the cases. In all cases the gall-bladder was removed because of disease. We were usually able to obtain a culture from the bile in about 7 per cent, and from stones, if they were present, in about 10 per cent, the wall of the gall-bladder produced a growth of bacteria in as high as 49 per cent. It is likely that, as Wilkie suggested, bacteria are destroyed when they come in contact with the bile, so tissues for bacteriologic study should not be exposed to bile. Wilkie¹⁹ has shown that cultures can be obtained much more often by culturing the tissue from the cystic gland at the neck of the gall-bladder than by culturing the wall of the gall-bladder. He believes this is due to the fact that the glandular tissue is not contaminated with bile.

We have fairly definite evidence to show that certain chemical changes in the blood may produce manifestations in the wall of the gall-bladder not unlike the condition spoken of as cholecystitis. It is possible that under certain conditions the chemical changes in the blood may be altered so as to result in this manifestation.

"Cholesterosis," presents an interesting study. If we think of cholesterosis as disease of the gall-bladder, it must be that this disease is due to changes in the metabolism. Occasionally there are stones in gall-bladders which show these changes, and sometimes there is associated inflammation in the wall, at other times the only change in the tissues is the deposit of lipid seen in the epithelial wall. It has been suggested by Sweet¹⁴ that this is an indication of the fact that the gall-bladder may play a part in the metabolism of fats.

The introduction of the method of studying the gall-bladder with the Rontgen-ray and dye test has added to the group of cholecystic changes one which must be termed functional cholecystic disease. This has enabled us to study the function of the gall-bladder and also permitted us to make a

diagnosis of disease based on disturbance of one or more of the functions. Undoubtedly these functions, concentration of the contents and equalization of the pressure, are most often altered when the gall-bladder is diseased. We should constantly bear in mind that this test is a functional test, and that a gall-bladder which is fairly normal histologically may be disturbed functionally. In our experience it has seemed that we were not justified in basing surgical procedures entirely on functional disturbance.

Besides the problem of infection, chemical changes in the blood, and metabolic and functional disturbances, there is another important one. There may be a definite clinical syndrome of disease of the gall-bladder and yet, at operation, disease cannot be recognized. In some of these cases the gall-bladder has been removed because of clinical symptoms and a number of the patients have obtained relief of symptoms. Because removal of the gall-bladder results in relief of symptoms does not prove, however, that the gall-bladder was diseased. The common duct is always dilated from loss of function of the gall-bladder, and, furthermore, the sphincteric action at the end of the duct is eventually overthrown. The real trouble in certain of those cases may be in the liver, in the form of hepatitis, or cholangitis, or the symptoms may be due to inflammation in the pancreas which might be affected by removal of the gall-bladder. Much is being said about the problems connected with the sympathetic nervous system and in this mechanism we may possibly have some such problem. There is a definite sphincteric action at the end of the common bile duct. Spasmodic action of this muscle might produce symptoms, and in view of the fact that cholecystectomy overcomes sphincter action, relief of symptoms might be obtained in this way.

We believe that cholangitis exists more often and to a more marked degree in association with cholecystitis than we formerly believed. If cholangitis can be recognized either with or without jaundice, then the common duct should be opened and drained. Drainage, as a rule, has not been maintained for a sufficient period. In fewer instances stones will recur if prolonged drainage is carried out. Prolonged drainage of the common duct undoubtedly enables the liver to recover its normal physiologic processes more readily. It is indicated in all cases in which there is recurrence of trouble whether it is due to reformation of stones or to a residual or a recurrent condition in the liver, pancreas, or ducts.

THE EFFECTS OF CONTINUOUS DRAINAGE OF BILE—Undoubtedly continuous loss of all of the bile through a draining sinus cannot be withstood indefinitely. It is difficult, however, to obtain any accurate data concerning the effects on the human being of the loss of all of the bile. First it is not possible to determine that all of the bile is coming to the outside because a biliary sinus exists. It has been readily shown in animals that a small amount of bile passing into the intestinal tract in a normal way changes the entire picture. There is no question, however, but that the continuous loss of bile eventually becomes very serious. In some of the cases in which

prolonged drainage has been carried out, marked general improvement is manifested as soon as bile is forced down into the duodenum. In others, tremendous quantities of bile continue to drain to the outside for a long time without any change resulting. Bile salts are undoubtedly very essential, and it is likely that the hepatic functions are stimulated better by bile salts than by anything else.

It has been shown experimentally that if all the bile is lost by drainage to the outside, the animal will die in a few weeks. It has been shown also that if these animals having complete biliary fistulas are fed on bile and liver, they will live almost a normal life.

SURGERY—If these conceptions of the physiology and pathology of diseases of the gall-bladder and bile passages are correct, then there is very little occasion for the operation of cholecystostomy except as a temporary procedure. If operated on at all, the gall-bladder should be removed, for it is undoubtedly only a part of a disease condition throughout the biliary tract.

The functional activities of the liver are carried on by two distinct epithelial systems. One of these is made up of the hepatic cells which are particularly active in the function of storing glycogen. They undoubtedly also have much to do with the formation of urea and metabolism of bile salts, as well as other functions. In all probability inflammation or obstruction in the bile ducts interferes a good deal with the activity of these cells. Even if disturbed for a long time, they may recover and even regenerate in cases in which there is actual destruction of some of the tissues. Surgical procedure is indicated then to remove inflammatory and necrotic tissue and to release all pressure in the bile ducts. The other type of hepatic cell is the endothelial which is called the stellate or Kupffer cell. This is a part of the general reticulo-endothelial system. Undoubtedly inflammation and obstruction of the biliary passages also interfere greatly with the activity of this cell. Relief of these conditions is indicated in biliary surgery in order to allow these cells to regain their function.

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CHRONIC CALCULOUS CHOLECYSTITIS

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IN FORMER years argument frequently arose as to whether cholecystectomy or cholecystostomy was the operation *par excellence* in the surgical treatment of gall-stones. Cholecystectomy, at least in the majority of minds, has triumphed, and cholecystostomy has been confined to the acute or rare chronic gall-bladder. With the advent of non-surgical biliary drainage, an impetus was given to the medical treatment of gall-bladder disease, occasionally a medical enthusiast stating that biliary surgery influences little the morbidity of the patient.

In an endeavor to throw some light on this subject, the "follow up" records of the Lankenau Hospital in all cases of biliary surgery during the years 1921 to 1925, inclusive, were carefully investigated.

This contribution deals only with chronic calculous cholecystitis, with or without an acute exacerbation. The results of acute cholecystitis and chronic non-calculous cholecystitis will be reported in the future.

The "follow-up" department of the Lankenau Hospital employs the following classifications. A A A means the end result which is considered anatomically, symptomatically, and economically perfect. In other words, the condition of the wound, the relief of symptoms, and the working capacity of the patient. A A A means a perfect result, and is the highest rating. D D D is the lowest result with survival, and E E E means ultimate death of the patient.

In the years 1921-1925 inclusive there were 400 patients operated for chronic calculous cholecystitis. Thirty-eight of these died as the result of the operation. Of the remaining 362, the "follow-up" records were incomplete in nineteen instances. This leaves 343 patients whose condition is known from three months to five years after operation. These are divided for convenience into fifteen groups represented by fifteen tables.

Table I deals with the cases of chronic calculous cholecystitis, in which a cholecystectomy was performed. One hundred seventy-four were heard from—148 had a perfect result, fifteen were improved, ten were no better nor worse than before operation. The percentage of improvement was 93.7. One patient died thirteen months after operation, the cause of death unknown but she had been entirely relieved of gall-bladder symptoms when last heard from. There were three cases in which an acute suppurative appendicitis complicated the gall-bladder disease. The appendix was removed in all but forty-six instances.

CHRONIC CALCULOUS CHOLECYSTITIS

TABLE I
Chronic Calculous Cholecystitis
Cholecystectomy

Number of cases	Time elapsed since operation	Condition		
		Anatomic	Symptomatic	Economic
2	To 3 months	A	A	A
16	3 to 6 months	A	A	A
1	3 to 6 months	A	B	A
1	3 to 6 months	A	C	D
1	3 to 6 months	B	C	B
9	6 to 9 months	A	A	A
2	6 to 9 months	A	B	A
1	6 to 9 months	A	D	A
1	6 to 9 months	D	D	D
9	9 to 12 months	A	A	A
1	9 to 12 months	A	B	A
1	9 to 12 months	A	C	A
18	12 to 15 months	A	A	A
3	12 to 15 months	A	B	A
1	12 to 15 months	A	B	B
1	12 to 15 months	E	E	E
17	15 to 18 months	A	A	A
1	15 to 18 months	A	D	A
1	15 to 18 months	B	B	B
3	18 to 21 months	A	A	A
1	18 to 21 months	A	B	A
5	21 to 24 months	A	A	A
1	21 to 24 months	A	B	A
1	21 to 24 months	A	B	B
42	24 to 27 months	A	A	A
3	24 to 27 months	A	B	A
11	27 to 30 months	A	A	A
2	27 to 30 months	A	B	A
2	30 to 33 months	A	A	A
1	30 to 33 months	B	A	A
3	33 to 36 months	A	A	A
9	36 to 39 months	A	A	A
1	36 to 39 months	A	B	A
1	47 months	A	A	A
1	54 months	A	A	A

Table II consists of chronic calculous cholecystitis in which a choledochostomy was performed in addition to cholecystectomy or a cholecystostomy alone was done. Of the former operations there were five, of these four had a perfect result one a very poor one. Of the latter operation there were

four, a perfect result was recorded in three and one was unimproved. The percentage of improvement was 77.7.

TABLE II
Cholecystectomy and Choledochostomy

Number of cases	Time elapsed since operation	Condition		
		Anatomic	Symptomatic	Economic
I	5 months	A	A	A
I	16 months	D	D	D
I	24 months	A	A	A
I	29 months	A	A	A
I	37 months	A	A	A

Cholecystostomy

Number of cases	Time elapsed since operation	Condition		
		Anatomic	Symptomatic	Economic
I	11 months	A	A	A
I	14 months	A	A	A
I	24 months	A	A	A
I	40 months	B	A	A

Table III is made up of the cases of chronic calculous cholecystitis with an acute exacerbation in which cholecystectomy was performed. There

TABLE III
*Chronic Calculous Cholecystitis with Acute Exacerbation
Cholecystectomy*

Number of cases	Time elapsed since operation	Condition		
		Anatomic	Symptomatic	Economic
I	To 3 months	A	A	A
10	3 to 6 months	A	A	A
2	3 to 6 months	A	B	A
I	6 to 9 months	A	A	A
I	6 to 9 months	B	A	A
8	9 to 12 months	A	A	A
I	9 to 12 months	C	A	A
5	12 to 15 months	A	A	A
6	15 to 18 months	A	A	A
I	15 to 18 months	A	B	A
3	18 to 21 months	A	A	A
9	21 to 24 months	A	A	A
I	21 to 24 months	A	B	B
5	24 to 27 months	A	A	A
I	24 to 27 months	A	B	A
I	27 to 30 months	A	A	A
2	33 to 36 months	A	A	A
I	33 to 36 months	E	E	E

were fifty-nine cases, fifty-one showing a perfect result, four improved, three unimproved and one fatality. The percentage of improvement was

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95 In nineteen cases the appendix was not removed, and in one case an acute suppurative appendicitis occurred as a complication. The one death occurred from subhepatic abscess six months after cholecystectomy and choledochostomy.

Table IV deals with chronic calculous cholecystitis complicated by chronic pancreatitis, for which several types of operation were performed. Twenty-five patients reported that they have since been in perfect health, two reported improvement, and one was in perfect health ten months after

TABLE IV
Chronic Calculous Cholecystitis Complicated by Chronic Pancreatitis
Cholecystectomy and Choledochostomy

Number of cases	Time elapsed since operation	Condition		
		Anatomic	Symptomatic	Economic
1	5 months	A	B	B
1	8 months	A	A	A
2	12 months	A	A	A
1	13 months	A	A	A
1	18 months	A	A	A
1	19 months	A	B	A
2	24 months	A	A	A
1	32 months	A	A	A
1	37 months	A	A	A
1	44 months	A	A	A
1	48 months	A	A	A

Cholecystectomy Only

Number of cases	Time elapsed since operation	Condition		
		Anatomic	Symptomatic	Economic
4	5 months	A	A	A
1	10 months	A	B	A
2	12 months	A	A	A
1	16 months	A	A	A
2	24 months	A	A	A
1	26 months	E	E	E
1	38 months	C	B	C
1	60 months	A	A	A

Cholecystoduodenostomy

Number of cases	Time elapsed since operation	Condition		
		Anatomic	Symptomatic	Economic
1	12 months	A	A	A
1	16 months	A	A	A
1	20 months	A	A	A

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TABLE IV—(Continued)

Cholecystostomy

Number of cases	Time elapsed since operation	Condition		
		Anatomic	Symptomatic	Economic
I	23 months	A	A	A

operation but died in twenty-six months, from angina pectoris. In one case there was a questionable malignancy of the pancreas, at five months reported A B B. The percentage of improvement was 90.

Table V represents chronic calculous cholecystitis complicated by stone in the common duct. Cholecystectomy and choledochostomy were done in all but one instance, where a cholecystectomy was sufficient to remove all stones, twenty-six were in perfect health and one was improved, the percentage of definite improvement being 96.4.

TABLE V

*Chronic Calculous Cholecystitis Complicated by Stone in Common Duct
Cholecystectomy and Choledochostomy*

Number of cases	Time elapsed since operation	Condition		
		Anatomic	Symptomatic	Economic
I	2 months	A	A	A
I	4 months	A	B	A
I	5 months	A	A	A
I	7 months	A	A	B
I	10 months	A	A	A
I	11 months	A	A	A
I	12 months	A	A	A
I	13 months	A	A	A
3	14 months	A	A	A
3	16 months	A	A	A
I	21 months	A	A	A
2	24 months	A	A	A
I	25 months	A	A	A
2	26 months	A	A	A
3	30 months	A	A	A
I	48 months	A	A	A

Cholecystectomy Only

Number of cases	Time elapsed since operation	Condition		
		Anatomic	Symptomatic	Economic
I	24 months	A	A	A

Table VI consists of several cases of chronic calculous cholecystitis with different complications, thirteen reported in perfect health, one was unimproved. The percentage of improvement was 92.8.

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TABLE VI
Chronic Calculous Cholecystitis with Complications

Complication	Number of cases	Time elapsed since operation	Condition		
			Anatomic	Symptomatic	Economic
Chronic pancreatitis and stone in common duct — Cholecystectomy and cholecystostomy	I	13 months	A	A	A
	I	49 months	A	A	A
Hydatid cyst of liver Subacute pancreatitis — Cholecystostomy Cholecystectomy	I	25 months	A	A	A
	I	35 months	A	A	A
	I	4 months	A	A	A
Cirrhosis of liver — Cholecystectomy Cholecystoduodenostomy	I	17 months	A	A	A
	I	5 months	B	B	A
	I	17 months	A	A	A
	I	18 months	A	A	A
Pancreatic lymphangitis — Cholecystectomy Cholecystectomy and cholecystostomy	I	16 months	A	A	A
	I	24 months	A	A	A
	I	25 months	A	A	A
	I	32 months	A	A	A
	I	36 months	A	A	A

Table VII consists of the cases of chronic calculous cholecystitis in which a previous cholecystostomy had been performed, and which were later subjected to cholecystectomy. Results: eight showed a perfect result, one was improved, and two were unimproved or worse than before the cholecystectomy. The percentage of improvement was 81.8.

TABLE VII
Cases Having Had Previous Cholecystostomy

Number of cases	Time between operations	Time since last operation	Condition		
			Anatomic	Symptomatic	Economic
I	3 months	10 months	A	A	A
I	12 months	25 months	A	B	A
I	12 months	49 months	A	A	A
I	17 months	24 months	A	A	A
I	6 years	24 months	A	A	A
I	7 years	13 months	A	A	A
I	8 years	13 months	A	A	A
I	8 years	24 months	A	A	A
I	12 years	14 months	C	C	A
I	12 years	25 months	A	A	A
I	14 years	10 months	A	A	C

Table VIII includes those cases of gall-stone disease in which a definite lesion was found in the gastro-intestinal tract, exclusive of appendicitis—

seven in all Five stated that they were perfectly well one was improved and one was unimproved

TABLE VIII

Chronic Calculous Cholecystitis with Complications of Gastro-intestinal Origin

Complication	Operations performed	Number of cases	Time elapsed since operation	Condition		
				Anatomic	Symptomatic	Economic
Duodenal ulcer	Pylorotomy, posterior gastro-enterostomy, cholecystectomy	1	24 months	A	A	A
	Excision ulcer, posterior gastro-enterostomy, cholecystectomy	1	26 months	A	A	A
	Excision ulcer, cholecystectomy	1	4 months	A	B	B
	No operation for ulcer	1	4 months	A	B	A
Diverticulum of duodenum	Invagination of diverticulum, choledochostomy, cholecystectomy	1	24 months	A	A	A
Carcinoma of appendix	Appendectomy and cholecystectomy	1	26 months	A	A	A
Mesenteric thrombosis	Thrombectomy and cholecystectomy	1	6 months	A	A	A

Table IX shows the cases in which a secondary operation was performed—eleven in number In one case there was no reply from the patient, five gave a perfect result, one was improved, and the other five were ultimately worse than before the operation

Table X consists of five cases whose histories are given in detail below, because of the severity of their illness and their many complications (but are not included in the above list) One had perfect result, one died, and the other three were worse than before operation

TABLE X

	Condition		
	Anatomic	Symptomatic	Economic
In detail—I	E	E	E
In detail—II	D	D	D
In detail—III	D	D	D
In detail—IV	D	D	D
In detail—V	A	A	A

Table XI shows the proportion of males to females There were seventy-four males, fifty-eight giving a perfect result, a percentage of 78.3, eight others were improved, 10.8 per cent, making a total percentage improvement

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TABLE IX
Cases Readmitted to Hospital

Primary pathology	Primary operation	Time between operations or treatments	Medical treatment	Secondary operation	Condition		
					Anatomic	Symptomatic	Economic
Cholelithiasis and abdominal adhesions—viscerop-tosis	Cholecystectomy—release of adhesions	4 months	Abdominal support for viscerop-tosis		A	I	I
Cholelithiasis and stone in common duct	Cholecystectomy, choledochostomy	7 months		Appendectomy	A	A	I
Cholelithiasis and chronic appendicitis	Cholecystectomy, appendectomy	13 months		Release of abdominal adhesions	A	A	I
Cholelithiasis and chronic appendicitis — viscerop-tosis	Cholecystectomy, appendectomy	2 months	Medical treatment—abdominal support for ptosis		A	A	I
Cholelithiasis and chronic appendicitis	Cholecystectomy, appendectomy	1 month		Release of adhesions—choledochostomy	A	A	A
Cholelithiasis—pus in common duct—chronic appendicitis	Cholecystectomy, Choledochostomy, appendectomy	6 months		Release of adhesions for intestinal obstruction	A	B	A
Cholelithiasis	Cholecystectomy	6 months (readmitted 4 months later)		Intestinal obstruction — incarcerated incisional hernia	C	B	A
Cholelithiasis—chronic pancreatitis—chronic appendicitis	Cholecystectomy, appendectomy	2 months		Abscess subhepatic incision and drainage	C	B	B
Cholelithiasis and abdominal adhesions	Cholecystectomy	3 months	Medical treatment for indefinite abdominal pain		C	C	C
Cholelithiasis — papilloma urethra	Cholecystectomy—excision papilloma	4 months		Carcinoma of liver	D	D	C
Cholelithiasis with acute exacerbation	Cholecystectomy	1 month		Cholecystoduodenotomy and posterior gastro-enterostomy	D	D	D

of 89.2. No deaths occurred among the males. There were 269 females, 230 giving a perfect result, or 85.5 per cent, seventeen were improved, or 6.3 per cent, making a total improvement of 91.8 per cent. There were nineteen cases in which there were no replies from the patients.

TABLE XI

Sex of patient	Number of cases	Condition		
		Anatomic	Symptomatic	Economic
Male	58	A	A	A
	8	A	B	A
	2	A	B	B
	1	A	D	A
	1	B	A	A
	1	C	A	A
	1	C	B	A
	1	C	C	A
	1	C	C	C
	1	C	C	C
Female	230	A	A	A
	17	A	B	A
	1	A	A	B
	3	A	B	B
	1	A	A	C
	1	A	C	A
	1	A	C	D
	1	A	D	A
	2	B	A	A
	1	B	B	A
	1	B	B	B
	1	B	C	B
	1	C	B	B
	1	C	B	C
	1	D	D	C
	3	D	D	D
	3	E	E	E

Table XII illustrates the duration of symptoms before operation in correlation with the "follow-up" record. The cases whose symptoms were less than six months totalled seventy-two and sixty-four of them stated they were perfectly well. Patients having symptoms from six to twenty-four months numbered seventy-six and sixty-two were perfectly well. From two to six years there were 126, with 107 having the best result. Those whose symptoms covered from six to thirty-five years numbered sixty-nine, with fifty-five perfectly well. It is interesting to note that the three patients whose symptoms had lasted twenty-five, thirty, and thirty-five years, respectively, all gave a perfect result.

Table XIII correlates the ages of the patients and the results. From ten to twenty years of age there were three, one being entirely relieved. From twenty to forty years there were 147, 122 reporting perfectly well. From forty to sixty years there were 166, 143 perfectly well. From sixty years onward there were twenty-seven, twenty-two of whom had perfect results.

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TABLE XII
Duration of Symptoms

Length of time	Number of cases	Condition		
		Anatomic	Symptomatic	Economic
1 to 30 days	22 2 1 1	A A B D	A B A D	A A A D
1 to 3 months	20 1 1 1	A A A A	A B B C	A A B D
3 to 6 months	22 1	A A	A B	A B
6 to 9 months	18 1 1 1 1	A A A B C	A B A B B	A A B B C
9 to 12 months	10 1 1	A A B	A B A	A A A
12 to 18 months	21 3 1 1 1 1	A A B C C D	A B B A B D	A A A A A D
18 to 24 months	13 1	A A	A B	A A
24 to 30 months	25 3 1 1	A A A A	A B B D	A A B A
30 to 36 months	24 1 1 1 1	A A A A E	A B B D E	A A B A E
3 to 6 years	58 6 1 1 1 1	A A B C D D	A B C B D D	A A B B C D
6 to 9 years	13 3 1 1 1 1	A A A A B C E	A B B C A C E	A A B A A C E
9 to 12 years	25 1	A C	A C	A A
12 to 15 years	7 2 1 1	A A A E	A B A E	A A C E
15 to 20 years	7 1	A A	A B	A A
20 to 25 years	1	A	A	A
25 to 30 years	1	A	A	A
30 to 35 years	1	A	A	A

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TABLE XIII

Age of patient	Number of cases	Condition		
		Anatomic	Symptomatic	Economic
10 to 15 years	1	A	A	A
15 to 20 years	1 1	A A	B D	A A
20 to 25 years	12 3 1 1	A A B D	A B A D	A A A D
25 to 30 years	28 3 1 1 1	A A A B C	A B D A A	A A A A A
30 to 35 years	37 3 1 1 1	A A B D E	A B A D E	A A A C E
35 to 40 years	45 3 1 1 1 1 1	A A A A B B C	A B B C B C B	A A B D A B B
40 to 45 years	40 1 1 1 1	A A C D E	A B C D E	A A C D E
45 to 50 years	35 5 2 1 1	A A A B E	A B B B E	A A B B E
50 to 55 years	43 4 1 1 1 1 1 1	A A A A A A C D	A B A A B C B D	A A B C B A C D
55 to 60 years	25	A	A	A
60 to 65 years	18 1 1 1	A A C C	A B B C	A A A A
65 to 70 years	2 1 1	A A A	A B B	A A B
70 to 75 years	1	A	A	A
Age not given	1	A	A	A

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Table XIV shows the number and type of operations performed for lesions in addition to the bile duct surgery

TABLE XIV
Operations Performed for Pathology Outside of Biliary Tract
(In addition to gall-bladder surgery)

Operation	Number of cases	Time elapsed since operation	Condition		
			Anatomic	Symptomatic	Economic
Perineorrhaphy D and C	1	12 months	A	B	A
Hæmorrhoidectomy	1	24 months	A	A	A
Excision polyp	1	25 months	A	A	A
Incisional hernia	1	24 months	A	A	A
Hysteropexy	1	25 months	A	A	A
	1	23 months	A	B	A
Trachelorrhaphy	1	17 months	A	A	A
D and C application of radium	1	24 months	A	A	A
Repair of ventral hernia	1	5 months	A	A	A
Subdiaphragmatic abscess—incision and drainage	1	26 months	A	A	A
Repair right inguinal hernia	1	4 months	A	B	A
Hysterectomy for myoma	1	11 months	A	A	A

Table XV illustrates the post-operative complications and some of their results

TABLE XV
Post-operative Complications

Complication	Number of cases	Time elapsed since operation	Condition		
			Anatomic	Symptomatic	Economic
Bilateral parotitis	1	36 months	A	A	A
Acute pancreatitis—incision and drainage	1	48 months	A	A	A
Pneumonia	1	2 months	A	A	A
	1	5 months	A	A	A
	1	12 months	A	A	A
	1	25 months	A	A	A
	1	34 months	A	A	A
	1	6 months	A	B	A
	1	8 months	C	B	B
Biliary fistula	1	14 months	A	A	A
Hernia wound	1	4 months	A	B	A
Cardiac attack	1	24 months	A	A	A
Secondary hæmorrhage	1	16 months	A	A	A
Bronchitis	3	Not of sufficient severity to affect results			
Stitch abscess	1	Not of sufficient severity to affect results			
Urinary retention	1	Not of sufficient severity to affect results			
Urinary suppression	1	Not of sufficient severity to affect results			
Phlebitis	2	Not of sufficient severity to affect results			
Cystitis	2	Not of sufficient severity to affect results			
Slight infection of wound	10	Not of sufficient severity to affect results			
Severe infection of wound	1	Not of sufficient severity to affect results			

CASE REPORTS

CASE I—Female, forty-three years of age, had suffered from upper abdominal attacks of pain during a period of six years. A cholecystectomy was performed for hydrops of the gall-bladder with stone, May 6, 1924. Following operation a biliary fistula developed. Patient was readmitted to the hospital September 26, 1924, at which time the fistula was excised and a choledochoduodenostomy done. This operation was complicated by a hernia of the omentum. Following the last operation she continued to have symptoms, with jaundice, and was again readmitted, December 6, 1924. She remained a week under medical treatment and then returned home, where she died in January, 1925. E E E

CASE II—Female, twenty-three years of age, had suffered from gall-bladder symptoms for about four weeks. She was admitted to the hospital March 6, 1924, at which time a cholecystectomy and appendectomy were done. Following this the patient continued to have symptoms of substernal distress, fever, deep jaundice, and a biliary fistula. A hepaticoduodenostomy was performed and the patient progressed nicely (although having an occasional pain in the epigastrium), until ten months after operation. Then she developed chills, fever, and jaundice, with attacks of intense pain in the epigastrium. On October 14, 1926, she was in a worse condition than before the operation. D D D

CASE III—Female, forty-three years of age, suffering from recurrent attacks of upper abdominal pain during a period of six years was admitted to the hospital June 3, 1923. A cholecystectomy was done. Following the operation a biliary fistula developed. She was readmitted July 2, 1923, when the fistula was repaired, a choledochoduodenostomy and a posterior gastro-enterostomy for pyloric obstruction were performed. Ten months following this she still had attacks of pain, chills, fever, and jaundice, and her condition showed no improvement. D D D

CASE IV—Female, thirty-eight years of age, was admitted to the hospital March 9, 1924, with the history of having had an operation for perforation of the gall-bladder in 1921, at which time the gall-bladder was removed piecemeal. At operation March 14, 1924, a portion of the gall-bladder was removed and an old biliary fistula excised. About twenty-four months later she began to have attacks of severe pain in the upper right abdomen, with chills, fever, and jaundice. She was readmitted April 13, 1926, when a choledochostomy was performed for chronic pancreatitis, nine months later she was still unimproved. D D D

CASE V—Female, fifty-one years of age, was admitted to the hospital November 3, 1924, with the history of attacks of pain in the right upper abdomen for five months, and a previous pyelotomy for stone in the right kidney. On November 6, 1924, a cholecystostomy for removal of gall-stones and an appendectomy and a right nephrectomy were performed. She was readmitted December 22, 1924, when a cholecystectomy and choledochostomy were done for stones and chronic pancreatitis, twenty months later she was much improved. On November 21, 1927, she was again readmitted and a second choledochostomy done for subacute pancreatitis. One month after last dismissal she was feeling very well. A A A

DISCUSSION

While the total operative mortality was quite high in comparison with some other clinics, this was contributed to by the severity of many of the cases and the necessity for extensive surgical procedures. Only three remote deaths occurred in the 343 cases whose records are known: one from an unknown cause eleven months after operation, a second from angina pectoris

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twenty-six months after operation, and the third from a subhepatic abscess six months after operation. Of the above 343 patients, 288 stated that they were perfectly well, or a percentage of 83.9 recoveries, 27 additional patients were improved, or a percentage improvement of 91.8.

The performance of choledochostomy, cholecystostomy, and cholecystoduodenostomy when indicated, although adding more risk to the immediate mortality, would seem to be justified by the excellent results obtained in the cases in which they were done. Gastric surgery or the fact that the patient had submitted to a previous cholecystostomy did not seem to influence the excellent results. Females had a better mortality record than the males. Duration of symptoms influenced the results less than is commonly thought. Those having symptoms for less than six months gave a perfect result of 88.8 per cent. Symptoms lasting from six months to two years showed a complete recovery for 81.5 per cent. From two to six years, 84.9 per cent had a perfect result, while 79.7 per cent of those with symptoms over six years had a perfect result. Age seems not to have influenced the result except in the cases of patients under twenty years, in which group only 33.3 per cent gave a perfect result. From twenty to forty years, 83 per cent were well. From forty to sixty years, 86.1 per cent were well. From sixty years onward, 81.5 per cent were well.

In the final result we must include the additional five cases considered in detail. Therefore, of 348 cases, 289 had a perfect result, or a percentage cure of 83 per cent.

From this review we feel that surgery in chronic calculous cholecystitis is of very definite value, and offers an assurance of relief of symptoms in a far greater proportion of cases than any other form of treatment.

ACCIDENTAL OR COMPENSABLE HERNIA¹

REPORT OF THE COMMITTEE OF THE AMERICAN RAILWAY ASSOCIATION
BY CLARENCE W HOPKINS, M D , OF CHICAGO, SOUTHGATE LEIGH, M D ,
OF NORFOLK, JOHN B WALKER, M D , OF NEW YORK JONATHAN M
WAINWRIGHT, M D , OF SCRANTON, AND WILLIAM B COLEY, M D ,
OF NEW YORK, CHAIRMAN

At a meeting of the Medical and Surgical Section of the Committee of Direction of the American Railway Association held in Washington on February 13 1929

A request for a definition of accidental rupture, was received from T H Carrow, Superintendent of Safety, Pennsylvania Railroad, dated May 25, 1927, with the recommendation that the following definition be adopted —

"Definition of Accidental Hernia Hernia should be considered accidental where there is real traumatic hernia resulting from the application of force directly to the abdominal wall, either puncturing or tearing the wall

"All other cases should be considered as either congenital or of slow development, being a disease rather than an accidental injury, unless conclusive proof is offered that the hernia was immediately caused by such sudden effort or strain that

- 1 The descent of the hernia immediately followed the accident
- 2 That there was severe pain in the hernial region
- 3 That there was such prostration that the employee was compelled to cease work immediately
- 4 That the above facts were of such severity that the same was noticed by the employee and communicated to the employer within twenty-four hours after the occurrence of the hernia
- 5 That there was such physical distress that the attendance of a licensed physician was required within twenty-four hours after the occurrence of the hernia "

In 1921 a Committee was appointed by the American Railway Association to make a careful study of the subject of Traumatic and Industrial Hernia In 1922 the Committee made this report and it was published in the ANNALS OF SURGERY and in the Proceedings of the American Railway Association

The findings of this Committee have been very widely adopted as representing the most recent opinion of representative American surgeons The more important question is, has it been accepted by the Courts and by Industrial Commissions? A careful study of the more important decisions made by the different State Commissions, especially in the "Hearing De Novo on the Subject of Hernia" held on October 11, 1923, at Philadelphia (in

¹ Presented at the annual meeting of the American Railway Association, May 8, 1929

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which four cases of the Glen Alden Coal Company were submitted to a Board of Commissioners), will show that the conclusions of our Committee on Traumatic Hernia have not been accepted without important qualifications. The following were the recommendations of our Committee in 1922:

1. Render proper compensation for all cases of true traumatic hernia due to direct violence. Such cases are so few in number as to be practically negligible.

2. Make a physical examination of all applicants for positions in industry no matter in what capacity, such examinations will determine the fact whether or not a hernia was present at the time of examination.

3. Any case of hernia developing in the course of duty, incident to the man's daily work, should be treated as a disease due to special anatomical weakness on the part of the individual, for which the Company is in no way responsible. If it is considered wise under certain circumstances to recognize any moral responsibility, let it be on an economic or humane basis. This moral obligation should be understood to be strictly limited to such employees who had been found apparently free from hernia at the time of previous physical examination.

In the Glen Alden Coal Company cases, Mr. Dever, the attorney for the plaintiff, bases his arguments on the following:

In the decision of the Clark vs. the Lehigh Valley Coal Company, the Supreme Court declared as law that no standard of fitness was required of an employee when he enters the employment to entitle him to compensation for injuries suffered while at work. In the Clark case, a workman had an ulcer in the aorta, and by a vomit at work, broke the ulcer at a time sooner than it would have broken by the natural progress of the disease, and the Supreme Court held that that was an accident and would support a compensation claim under our Act.

In the Clark case above referred to, the Supreme Court set at rest both propositions advanced by the employer in this lawsuit, in its effort to defeat a compensation claim for the hernias here in question. The first proposition is that no matter how weak the body is at a particular part, if something happened at work causing the final break, it is compensable, and the second proposition is that with a weak part within the body due to any cause, compensation is to be paid not only for the damage done by the last effort, but for the damage done by all efforts, if the last strain at work caused the final break.

At the Glen Alden hearing each of their experts, when testifying, agreed that "there was a strain at work and they all gave evidence that each push, each effort, each exertion, plays its part in the development of the whole, and yet they would have you believe, in these specific cases, that the last effort made no difference. They cannot convince intelligent men that the last strain at work did not play a part in the development of these hernias, when they admit that each strain does not play a part in the final product."

The following quotation from the Counsel for the Defendant's Brief gives the other side of the picture:

'There is no doubt that Doctor Biddle agrees with Doctor Wainwright, Doctor Coley, and the other doctors who testified on behalf of the defendant, not only in their

views as to the origin and cause of hernia, but that a true hernia as distinguished from a potential hernia was present and existing prior to the alleged accident in all three of these cases

"The question in these cases, therefore, may fairly be stated to be whether the accident caused an aggravation of a preexisting hernia if this is answered in the negative no further inquiry need be made, if in the affirmative, then comes the further question as to the effect of the aggravation on the man's ability to work

"While there has been no suggestion of fraud in any of the three cases here presented, errors having the same effect creep into every hernia case. The man suffering from a hernia, or from any other condition which he does not fully understand, almost invariably and immediately looks for some external cause. Incidents which would ordinarily be passed unnoticed, or be soon forgotten, when followed by pain or other untoward circumstances, are immediately thought of as being the cause thereof. The average man suffering from a hernia cannot be convinced that the cause was not the trivial accident which the doctors all agree merely brought it to his attention, and in this connection is a most sincere and impressive witness

"So after eliminating all improper factors, we consider the questions

"A Did the alleged accidents aggravate a preexisting condition of hernia? and

"B If so, did the aggravation cause disability beyond the ten-day period?

"The position of the claimants, therefore, may be summarized thus. The employee is suffering from an existing condition which should be operated upon to effect a cure. The accident caused a change in this condition which is so slight and infinitesimal that it cannot be distinguished except by reasoning from effect to alleged cause—innumerable strains are the cause of the condition, therefore, each strain has played its part—and then, while the alleged changed condition does not interfere with the man's ability to do this work, merely because the employee may choose this particular time for an operation, claimants ask the employer not only to pay for the cure, but also to pay compensation for the time which is lost in convalescence

"If claimants choose to continue to work, which they may do as the doctors all agree, the next day or the next week another similar incident will likely occur, of this the evidence leaves no doubt. This offers another opportunity to file a claim petition, and affords a basis for a demand for a cure and for compensation, or, why not go back and allow the employee to choose from any number of employers for whom he may have worked during the statutory period of one year, and make this choice as to who shall be liable for the expense of the operation, and the compensation payments during the period of his disability following the operation

"The evidence clearly shows that the hernias suffered by claimants were of slow development. They came on gradually from continued strains and intra-abdominal pressure at work and away from work since the birth of claimants, and therefore not compensable because they are natural occupational in character."

In two out of the four cases the decision rendered was in favor of the employer and two in favor of the employee

Following the decision in these cases, Chairman Walnut made a lengthy memorandum on the whole subject, entitled, "Hernia As a Compensable Accident under Workmen's Compensation Act of Pennsylvania" from which we quote the following

Under the title of "Accidental or Sudden Hernia," he quoted Doctor Mock who states,

"The great majority of hernias develop slowly—the gradual dilatation by mesentery of a preformed sac. The congenital defect or predisposition is the chief cause for such hernias, and the relation of natural occupation or of the natural acts of ordinary life

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is immaterial in their formation. These correspond to the gradual development of 'flatfoot,' as a result of faulty shoes, constant standing and walking or other natural causes, or to the development of tuberculosis in employes engaged in occupations which in no wise predispose to this condition.

"A small percentage of these hernias, however, make their first appearance after some unnatural occupational hazard which is out of all proportion to those ordinary or natural conditions. These correspond to the occupational diseases which are now recognized in some states as accidental and, therefore, compensable. These are border-line cases, for which no hard and fast rules can be laid down. The individual merits of each case must be carefully considered to arrive at an equitable settlement.

"Those surgeons who claim that only the true traumatic hernia is compensable do a great injustice to many employes. Those industrial commissions, which claim that all hernias developing as a result of 'strain' are compensable, do a great injustice to the employers. Both views are responsible for many of the fraudulent claims made for compensation by dishonest employes.

"Traumatic hernia is a misnomer as it indicates the very small group of hernias resulting from direct violence. Other types of hernia develop for which the occupation is more or less responsible and are described by Lothiessen and other German writers as 'accidental hernia'.

"I wish to advocate, therefore, that the term 'compensable hernia' be adopted in this country by both the medical and legal professions, and further, that this term shall include all cases of true 'traumatic hernia' and all cases of 'accidental hernia' in which the force causing their development is directly the result of some unnatural occupational hazard."

The rules adopted by the Nevada State Commission (quoted herewith) agree with the position taken by Doctor Mock.

"Rule 1. Real traumatic hernia is an injury to the abdominal wall (belly wall) of sufficient severity to puncture or tear asunder said wall and permit the exposure or protrusion of the abdominal viscera or some part thereof. Such injury will be compensated as temporary total disability, and as partial permanent disability, depending upon the injured individual's earning capacity.

"Rule 2. All other hernias, whenever occurring or discovered and whatsoever the cause, except as under Rule 1, are considered to be diseases, causing incapacitating conditions of permanent partial disability, and the causes of such are considered, as shown by medical facts, to have either existed from birth, to have been years in formation, or both, and are not compensatory, except as provided under Rule 3.

"Rule 3. All cases coming under Rule 2 in which it can be conclusively proved (first, that the immediate cause which calls attention to the presence of the hernia, was sudden effort or a severe strain or blow, received while in the course of employment, second, that the descent of the hernia occurred immediately following the cause, third, that the cause was accompanied or immediately followed by severe pain in the hernial region, fourth, that the above mentioned facts were of such severity that they were noticed by the claimant and communicated immediately to one or more persons) are considered to be aggravations of previous ailments or diseases, and will be compensated as such for time or loss only, depending on the nature of the proof submitted and the result of the local medical examination."

Our Committee of the American Railway Association in discussing the Rules of the Nevada Commission agreed unqualifiedly with Rules 1 and 2 but with regard to Rule 3 made the following statement:

"Hernia is practically always due first, to the presence of a preformed sac or open pouch of peritoneum which, in the inguinal variety follows the

testis in its descent into the scrotum, which pouch has failed to close in the normal way and second, to the presence of structural weakness in the neighborhood of the hernial orifices due to poorly developed muscles or fascia. Given these all-important anatomical causes which are in themselves sufficient in many cases to constitute a potential hernia, the actual hernia may develop by reason of a great variety of exciting causes, among these may be mentioned, the daily increase in intra-abdominal pressure incident to the ordinary routine of life, *e g*, straining at stool, coughing, sneezing, lifting, etc. The main point that cannot be emphasized too strongly is that the hernia is never the result of a single strain or single increase in intra-abdominal pressure due to any of the causes mentioned, on the other hand, it is the cumulative effort of a great number of strains spread over a considerable period of time. In nearly all cases hernia is a gradual onset, and is rarely accompanied by pain, and most frequently remains unnoticed until it reaches a considerable size or until some accident or strain by slightly increasing the contents of the hernial sac, causes it to be noticed for the first time. Hence, the accident or strain is usually the occasion which first attracts the attention to a hernia long present but hitherto undiscovered."

The decision of the Pennsylvania Commissioners in the hearing of the four cases *loc cite* leans toward the position taken by Doctor Mock and the Nevada Commission.

As a matter of fact, out of the four cases decided, two of the four were in favor of the employer and two were in favor of the employe. So it is evident that the problem has not yet been definitely settled.

In the elaborate memorandum of this hearing formulated by Chairman Walnut—Subject: Hernia as a Compensable Accident under the Workmen's Compensation Act of Pennsylvania—the position taken by our Committee is quoted at length and discussed in a most fair and judicial manner. In addition, the opposing views are likewise presented. In his conclusions, Chairman Walnut states:

"A Legal Definition of Accident—The Pennsylvania Statute provides for the payment of compensation for personal injury to, or for the death of 'an employe' by an accident in the course of his employment. The terms 'injury' and 'personal injury' as used in this Act shall be construed to mean only violence to the physical structure of the body and such disease or infection as naturally result therefrom."

The word "accident" has been so frequently interpreted that it is unnecessary to review the decisions. Briefly, however, it should be pointed out that in order to constitute a compensable injury under our statute, it is not necessary that it be caused by the unforeseen and unexpected application of external force. It may include a strain to which the employe has voluntarily subjected his body in the course of his employment and which has proved to be greater than his body could bear, as a result of which the injury occurred. It is unnecessary that the strain, to which the employe's body is so subjected, be an unusual strain. It is the unusual and unexpected

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injury resulting from a particular strain that constitutes the accident (See *Smith vs Pittsburgh Coal Company*, 71 Superior, 325, 1919, 11 Mackey, 71, Tracy vs Philadelphia & Reading Coal and Iron Company, 270 Pa, 75, Watkins vs Pittsburgh Coal Company, 278 Pa, 463, Samoskie vs Philadelphia & Reading Coal and Iron Company, 280 Pa, 203)

In the first of the cases cited the question before the Court arose in connection with a hernia designated as umbilical. In the course of the discussion, it was contended that the employee's condition was not due to an accident, but to the development of an existing hernia, the existence of the hernia, prior to the alleged accident, being admitted by the claimant. The referee, however, found that this condition had never caused the employee any pain, inconvenience, or disability prior to the accident. This finding was affirmed by the Board together with his conclusion that the result of the accident, consisting of a change in the condition of the hernia, resulting in disability, constituted a compensable injury. It was, therefore, a clear case of the acceleration of the growth or development of a hernia due to a strain as the exciting cause.

The contention of the defendant "that the preexisting condition of the claimant's body was the cause of the injury and not his effort to lift the car" was not viewed with favor by the Lower Court, which stated

"It would be unprofitable to undertake to lay down any rule by which events which precede other events may be determined to be or not to be causes of them. We have to deal with a matter which is not metaphysical, but practical. The real question is, of what nature and extent, a bodily defect or a bodily condition different from that of the average man must be, to require us to determine that an accident which would not have harmed a normal person, was not the cause of the injury, or what is more to the purpose in the present case, is not compensable under the Act (Shafer P J) 1 Mackey, 88"

This analysis of the question was approved by the Superior Court

"B Application of Medical Principles—It is with this understanding of our law that we have considered the medical discussions both in the testimony and in the writings of the several physicians. It is clear to us that our law, as interpreted, requires us in cases such as these to determine, not so much the cause of the hernia as the condition of disability. Not so much the predisposition as the degree in which the exciting cause contributed to the condition of disability. The effect of the violence or strain must be appreciable, not only in a scientific sense, but in the ordinary sense in which we use the phrase 'contributory cause'."

As we have already suggested the recommendations of the Coley Committee were in line with the testimony of the defendant's physicians. These recommendations would entirely exclude hernias begun or accelerated in development either by extraordinary or ordinary efforts or strains, to which an employee may be subjected in the course of his work. The so-called hernias of effort

In view of what we have already stated as to the scope of our statute we would have no authority to follow such recommendations

We are satisfied from a consideration of the various medical statements on the subject that the physicians themselves relate a hernial condition in a reasonable number of cases to the cause to which it is ascribed by the patient. Doctor Coley, himself, certainly in his earlier utterances, at least, recognized this relationship. In his address in 1903, he suggests that a casual connection must be recognized "since a preexisting hernia has been made worse by the accident or injury"

The Committee of the American Railway Association believes that according to the Law of the State of Pennsylvania many of the cases of hernia might be helpful both to employer and employes. In our former report we used the term traumatic and industrial hernia for three groups

1 Using the term traumatic to include only the very small group of cases in which the hernia was caused by direct local violence

2 Under the heading Occupational Hernia and Industrial Hernia or better the French term "*Hernia d' Effort*," to include all the cases which appear suddenly or at least are suddenly recognized following some unusual intra-abdominal strain and which have been attributed to a great variety of causes *e g*, coughing, straining, lifting, sudden falls. It is this group which furnishes all the medical legal difficulty and the many knotty problems that have come before the Compensation Commissions and the Courts. The relative number of cases that come in this group is about 25 per cent of all cases. Hutchinson estimates it at 75 per cent in adults

Doctor Coley in an address, read before the New York and New England Association of Railway Surgeons, November 14-15, 1907, reported upon 4797 cases of hernia in males, personally observed, of which 3102 cases attributed the hernia to no one cause, while the remaining 1695 cases, the following causes were given by the patient: 1015 lifting weights, 150 coughing or sneezing, 123 push, fall or twist, 27 straining, 89 fall, 34 slipping, 40 blow, 8 kick, 20 running or jumping

In a goodly proportion of cases, *ie*, nearly 25 per cent of the total of hernia of effort the cause of the hernia was believed to be lifting or carrying some weight. I think it is fair to assume that in the majority of these cases in which the hernia appeared directly after some unusual effort, there existed some relation of cause and effect. Yet, we may still here assume the presence of a preformed sac, latent and empty up to the time of the unusual effort which increased the intra-abdominal pressure to such an extent as to force a portion of omentum or bowel into the empty hernial sac thus producing an actual hernia. We must not forget that a sac which had been up to the time of the accident without contents does not constitute a true hernia. There must be or must have been, something in the sac to make it an actual hernia, and just here is where the wide divergence of opinion arises. One group of writers considering with Kingdon, that a

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hernia is always a disease, the other group regarding it as always due to an accident. Neither side is quite correct.

3. In the third and by far the largest group, made up of three-quarters of all cases, the hernia has developed so slowly and without any local injury or accident, that the person frankly states he knows no cause to which he can attribute it. This group of cases it is quite fair to regard as due to developmental defects and in the nature of a disease rather than an accident. All agree that none of these cases is compensable.

To go back to group 2, Industrial Hernia, Hernia d' Effort and Accidental Hernias. Are these cases compensable and if so, what are the criteria upon which to decide whether they are or are not?

In our former report we attempted to show that in practically all of these cases of oblique inguinal hernia, the hernia was due chiefly to the presence of a preexisting congenital sac which had remained without contents until the gradual and repeated strains incident to daily routine or occupation caused a gradual dilatation until large enough to receive a little omentum at first and later a portion of the bowel.

That a hernia of considerable size and with both bowel and omental contents can exist and often did exist without any symptoms and without the person's knowledge has been definitely proven. If by reason of some sudden and unusual strain associated with a fall or heavy lifting, a larger portion of bowel or omentum is forced into this preexisting sac, pain and discomfort may follow. The patient feels of the parts, finds a lump and goes to his physician who diagnoses a hernia and the man honestly believes it was definitely caused *de novo* by the accident in question.

The Committee held the view that in such cases the hernia existed before the accident which merely enabled the man to recognize a condition that was present and emphasized the need of operation or proper treatment. We are quite willing to admit that in certain States, the mere fact that the accident caused some aggravation of a hernia already present, might warrant considering it compensable.

Many large industrial corporations have recognized the fact that they have very definite obligations to keep their employes in the best physical condition possible and that from a selfish point of view alone it might be to the advantage of the company to take a man who by reason of his hernia and without regard to responsibility for its causes is able to render only 75 per cent of his capacity, pay his board in a hospital for two and a half weeks to pay a small surgical fee of \$50.00 to restore him to 100 per cent working capacity. Therefore, some corporations have adopted the practice of giving any employe who develops a hernia while at work for the company an operation and hospital expenses without cost to him.

Inasmuch as most companies have adopted physical examinations on entrance to service, these will be the only cases that will have to be taken care of by the company and it will be found they will be comparatively few in number.

We are inclined to believe this may be the best solution of the problem. In fact in our last report in our third recommendation we suggested practically this method of dealing with these cases. In other cases in which the corporation will not adopt this liberal method of dealing with hernia d' effort, what is the best plan to pursue? We are inclined to believe that Rule 3 of the Nevada Commission or Doctor Mock's three rules, probably the best and they will safeguard the employer against any large number of compensable cases. At the time we made our earlier Report, most of the cases of hernia were dealt with in the Courts and many fraudulent claims had been made and often large damages awarded.

Doctor Coley recalls one case in his own experience in the New York Central Railroad Company in which a man was in a slight collision, no one was seriously injured but this man claimed to have been thrown against the seat in front and produced a large double oblique inguinal hernia. Any person with any large experience in hernia would not hesitate for a moment to state that both of these hernias had been of long duration, probably two or three years, and it is quite impossible that either was caused by the injury in question, and yet a jury gave an award of \$15,000 in this case, which, however, was not sustained in the Court of Appeal.

In those days, it was generally believed by the juries that hernia was often caused *de novo* by the accident and hence the large damages. At present both Courts and Compensation Boards have come to recognize the main contention of the Committee, *viz*, that a hernia is almost always of slow formation and not due wholly to a single accident or strain and that the most that can be claimed is an aggravation of an already existing trouble. This is shown by the very small awards recently allowed by Compensation boards. In the Glen Alden cases there was a total award of about \$144 given in each case.

If the report of the Committee has accomplished nothing more than this great change of viewpoint on the part of the Courts and Commission Bureaus, we believe the Committee well rewarded for all its trouble.

It will be seen from the foregoing that it is very difficult to accurately define in a few words, accidental or compensable hernia. The definition of accidental hernia given by Mr T H Carrow, Superintendent of Safety, Pennsylvania Railroad, at the opening of this report is very good and in harmony with the views of our Committee. The definition given by Doctor Mock just quoted is perhaps even better.

THE TREATMENT OF ELECTRIC BURNS BY IMMEDIATE RESECTION AND SKIN GRAFT¹

By DONALD B. WELLS, M.D.
OF HARTFORD, CONN.

ELECTRIC contact burns differ from all other types of burns in four major characteristics (1) The heat which produces these burns is far more intense than the heat which produces any other type of burn, and this heat is usually applied for an infinitely shorter space of time than the producing heat in any other type of burn (2) As a result of this intense heat, often of only instantaneous duration, a pathological picture is found radically different both in its gross appearance and in its microscopic detail from the pathological picture of any other type of burn (3) This unique pathological picture gives rise to a natural history and clinical course materially different from that observed in ordinary burns or scalds (4) Based on the foregoing considerations a radical method of treatment has given results which, so far as we have been able to ascertain, have not been secured by any other method employed

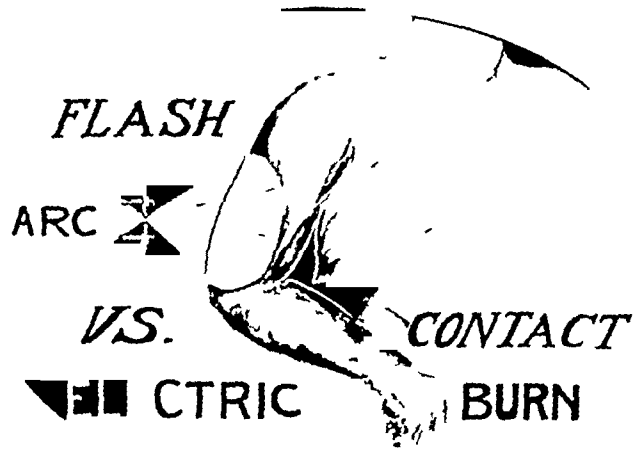


FIG. 1.—Diagram illustrating difference between a flash burn and a contact burn

This intense heat, distinctive pathological picture and characteristic clinical course are only observed in electric contact burns. They are not found in the so-called flash burns. The distinction between a flash burn and an electric contact burn is clearly shown in the first figure. A flash burn may be sustained when an electric arc is formed between two poles close to the body. The severity of the burn sustained will depend upon the proximity of the tissues to the electric arc and the length of time that the arc is maintained. Such a burn does not differ in any material way from an ordinary burn or scald, the intense heat of the electric arc being disseminated over a relatively large surface area and diminished in geometrical ratio proportionate to the distance of the tissue from the electric arc. By contrast, in the case of an electric contact burn, the type of electric burn which we are considering, the surface of the body forms one of the poles of the electric arc. The electric current passes through the body and the degree of heat attained at the point on the surface of the body where

* Read before the Connecticut State Medical Society, May 22, 1929

the contact is made is the temperature of an electric arc. If a burn is produced, no matter how small, an electric arc must have been formed. If the contact is so perfect that sufficient resistance is not introduced to develop an electric arc, the body simply sustains an electric shock, which may produce anything from a slight tingle to instant death.

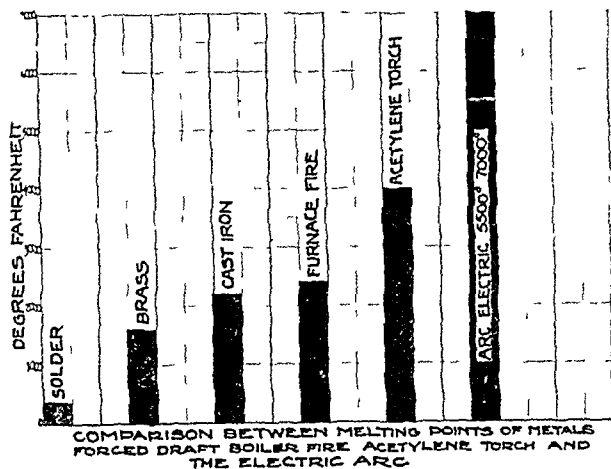


FIG 2—Diagram comparing melting points of solder, brass, and cast iron with temperature of the electric arc

which will cut through the plates of a battleship, is 1000 degrees less than the minimum temperature of the electric arc. No wonder that the electric arc melts every body tissue, even bone.

This intense, almost incomprehensible heat results in a pathological picture which is characteristic. The size of the burn and perhaps certain secondary features, such as may result from ignition of the clothing, for instance, depend upon whether the electric arc was a single flash or continued for a perceptible length of time. Upon casual inspection the victim of an electric contact burn may present simply a single small blister.

More often, particularly when the palmar surface of the hands is involved, the macroscopic lesion consists of a number of isolated discrete blisters. These look insignificant, and we have seen a patient discharged from the Accident Room by a House Officer who had no idea that the burns were serious, as the external manifestations appeared so trivial. But, if the superficial blister is carefully cut away, even the smallest electric burn presents a characteristic appearance. In the smallest burns there is a central area of white necrosis, often not more than a quarter

The second figure shows the relative temperature of an electric arc as contrasted with the temperature of other forces which may produce burns. The intractable character and long drawn-out clinical course of metal burns is well known, yet the melting point of cast iron is only 2200 degrees as contrasted with the temperature of an electric arc, which varies from 5500 to 7000 degrees. The acetylene torch,

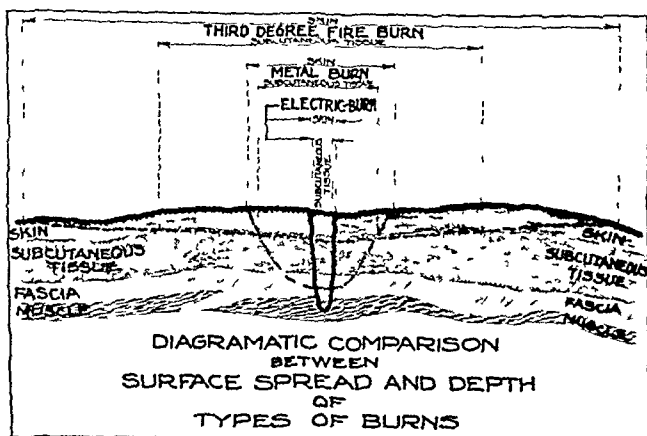


FIG 3—Diagram illustrating relationship of surface spread to depth of various types of burns

of an inch in diameter, surrounded by a narrow ring of hyperæmia. Larger electric burns present a central excavated area—dry, crusted and bloodless where the tissue has been absolutely burned away. This central excavated area is always surrounded by the characteristic zone of pallor, or white necrosis, which in turn is encircled by a narrow ring of hyperæmia or œdema.

The second characteristic feature of the gross pathological picture of an electric burn is the relationship of surface spread to the depth of the burn. This is diagrammatically shown in our third figure. The ordinary third degree fire burn such as might be sustained if one's clothing caught fire,



FIG. 4.—The specimen is a fusiform piece of skin $3\frac{1}{2}$ by 2 cm. and with the subcutaneous tissue is 7 mm. in thickness. In the centre of the skin there is a shallow ulcer crater, $1\frac{1}{2}$ cm. in its greatest diameter. The base of the ulcer is covered by a black deposit. The margins are somewhat retracted but not definitely undermined. There is no thickening of the epithelium. On section the skin is of ordinary appearance at the margin. In the central portion the epithelial layer is absent. There is no induration at the base of the ulcer and the black pigmentation extends only a slight distance beneath the surface. (K) *Microscopic*.—At the margin the surface is covered by a normal stratified epithelium. At the area of ulceration the epithelium is absent and the underlying structures for a considerable depth show complete necrosis. The cellular architecture is still preserved though none of the cells stain normally. There is no œdema and no inflammatory infiltration. This area of necrosis is quite sharply demarcated on all sides. At the margin of the ulcer the superficial epithelium is necrotic and slightly separated from the underlying tissue. (K)

covers a relatively large area. A wide peripheral ring of erythæmia, an intermediate circle of vesication and a central area of slough—all three areas ill-defined, merging into each other, relatively widespread over the surface and seldom extending deeply into the subcutaneous fat—these are the characteristic features of an ordinary fire burn. A metal burn, on the contrary, is ever so much more circumscribed. There is a comparatively narrow peripheral ring of erythæmia and vesication with a fairly well-defined central area of necrosis almost invariably extending well down into the subcutaneous areolar tissue. The electric burn stands out in marked contrast, sharply circum-

scribed, only the narrowest ring of erythema surrounding a dead white central area of necrosis which always extends well into the subcutaneous tissue,

often includes the muscle and tendonous structures and sometimes even bone

To be sure, the necrotic area is seldom perfectly cup-shaped, the necrosis tends to follow the direction of the current, is irregular in outline and often surprisingly extensive. But the necrosis is strikingly well-defined and sharply circumscribed

The fourth figure, a microphotograph of a horizontal section through an electric burn resected within a few hours of the time it was sustained, clearly shows all these distinctive pathological features. Note the circum-

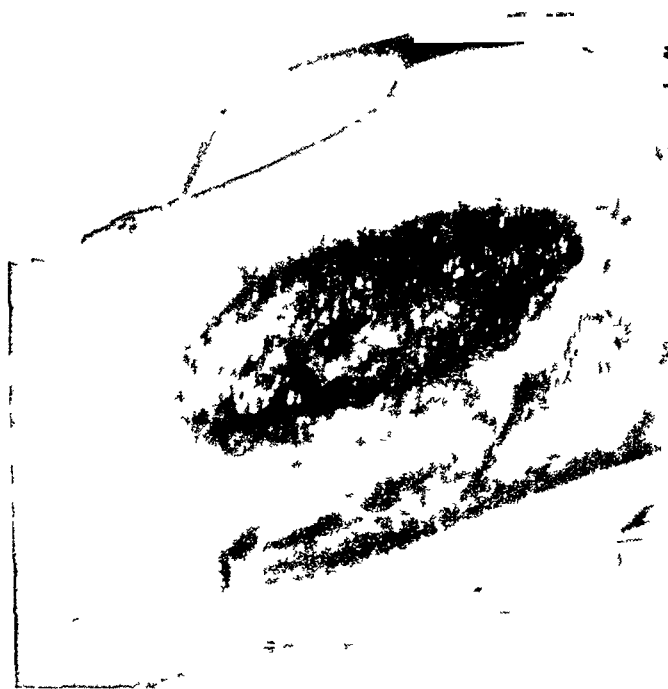


FIG 5—Electric burn of arm

scribed character of the burn. Here are normal, living cells, and here, not an eighth of an inch away, are cells which are certainly dead. Note the relative depth of the burn in proportion to its surface spread. Note the homogeneous, poor staining, melted appearance of the cells, though the architecture can still be distinguished. How obvious that every bit of this slough must be thrown off before the burn will heal and how certainly this process will be slow, long-drawn-out, tedious to the patient and discouraging to the surgeon.



FIG 6—Electric burn of foot

The discouragement suggested by this pathological picture is borne out in the natural clinical history of electric burns. As a rule, in from thirty-six to forty-eight hours, an electric burn loses its dry, crisped, circumscribed

TREATMENT OF ELECTRIC BURNS BY SKIN GRAFT

appearance to become a serum-saturated area with disintegrating walls and floor, progressing to profuse purulent secretion, gross sloughs bathed in pus exuberant granulations—a disorganization impossible to check with the most radical antiseptics or scrupulous asepsis.

This disorganization may include muscle, tendon, joint capsule even bone itself. After a varying period always from a clinical standpoint apparently unduly tedious and prolonged firm granulation ultimately ensues and

the final result will be as good as is ordinarily secured in other comparable burns.

The complete resection of gunshot wounds, more usually spoken of as débridement, and their immediate closure by primary suture or their delayed closure after a few days of chemical sterilization, was a technic developed and perfected during the World War. The application of this principle of complete resection and immediate closure by suture or skin graft to third degree electrical burns has not been reported in the literature, nor has it apparently ever been successfully applied so far as we have been able to learn after diligent inquiry among surgeons who must



FIG 7—Electric burn of foot



FIG 8—Same arm as shown in Fig 5 at first dressing on fourth post operative day

come into frequent contact with the results of electrical traumata. But a consideration of the pathological picture, the unsatisfactory results of expect-

ant treatment and some experience with the debridement of gunshot wounds during the World War encouraged us some time ago to attempt to apply this therapeutic principle to electric burns. The results were surprisingly and uniformly satisfactory, so much so that we would not, by choice, consider any other method of treatment where this particular method is applicable.

The method has its limitations, the line of demarcation may not be sufficiently clear in tendons, cartilage or bone to warrant an immediate resection of the eschar. As always, discretion is the better part of valor. Essential structures, such as large vessels, nerves and joints should certainly be spared, if there is any doubt in the operator's mind as to their possible viability. But experience has taught us that the great majority of electric



FIGS 9 and 10—Condition of case shown in Fig 7 three weeks after disarticulation of toes and skin grafting

burns are far more successfully handled by complete resection and immediate closure by suture or skin graft, than by any other method.

During the past three years we have had a small series of electric burns treated by complete resection and closure of the wound, either by primary suture or immediate skin graft. Two typical cases may be recorded as representative of the results obtained by this method of treatment.

Our first case, Mr. D., represents the ideal treatment—complete resection of the eschar and immediate suture of the wound. He was “hung up” on July 22, 1927, when he came in contact with an 11,000-volt current. He was not rendered unconscious. The principal burn on the anterior aspect in the lower third of the left thigh was about one inch in greatest diameter. This eschar, and one of four smaller wounds, was resected and closed by primary suture. Fig 4, to which attention has previously been called, is a microphotograph of an horizontal section through the larger of these burns. He was discharged from the hospital the day following the operative procedure, the sutures were removed a week later, and he was climbing poles sixteen days after he had sustained the burns.

Our second case, Mr. N., sustained the most extensive electric burns that have come under our care since this method of treatment was undertaken. He was “hung up”

TREATMENT OF ELECTRIC BURNS BY SKIN GRAFT

on the top of a pole on June 18, 1927, when he came in contact with a current of 4800 volts. A fellow employee two poles away saw him sizzling up among the wires, ran a distance of some three hundred feet, climbed the pole on which Mr. N. was "hung up," knocked him loose, and lowered him to the ground where others instantly began artificial respiration. Mr. N. was conscious and oriented when we saw him at the hospital. There was an eschar in the lateral aspect of his left arm involving the triceps muscle and insertion of the deltoid. Fortunately the musculospiral nerve had escaped injury. The extent and typical character of this burn are rather inadequately shown in Fig. 5, a photograph made in the Accident Room on his admission. The right great toe was practically burned off. The second and third toes were badly burned and the fourth toe superficially involved. The injury to the right foot is shown in Figs. 6 and 7.

Three hours after the burns had been sustained the entire eschar in the arm including the area of white necrosis, was resected *en bloc*. This included about a third



FIG. 11.—Same arm as shown in Figs. 5 and 8 completely healed six weeks after burn was sustained.

of the triceps muscle and part of the deltoid. The bleeding was completely controlled by innumerable fine ties and hot towels. Thiersch grafts were then cut from both thighs and the operative wound, which actually measured eleven by seven inches, completely covered. Our courage somewhat failed when it came to the foot; the great toe was amputated through the lower part of the first metatarsal, parts of the next three toes were removed, and transverse parallel slits were made through the necrosed skin and subcutaneous tissues on the dorsum of the foot.

Fig. 8 shows the arm at the time of the first dressing on the fourth post-operative day. Unfortunately a large graft was pulled off the very center of the wound in removing the dressing, which consisted of silver foil immediately overlaid with gauze. We have since improved on this



FIG. 12.—Comparative view of the two arms to show the depth of the burn.

dressing, and now use silver foil overlaid with a layer of paraffine mesh and vaseline gauze, which anchors down the foil and prevents the gauze from sticking to the graft

On July 8, twenty days after the first operation, the second toe was disarticulated at the metatarsophalangeal joint, the gangrenous tips of the third and fourth toes removed, and about one hundred and forty small deep grafts were cut and applied to the granulating area on the foot. The result of this procedure is seen in Figs 9 and 10 which show the result twenty-three days later, when Mr N was discharged from the hospital

Figs 11 and 12 show the arm on the day Mr N was discharged from the hospital, exactly six weeks after the burn was sustained. All dressings had been omitted from the arm five days previously (July 25). The man returned to work August 15, exactly eight weeks from the day he sustained his burns, and climbed a forty-five foot pole as a demonstration of his condition. Fig 13 shows the absence of operative reaction or any

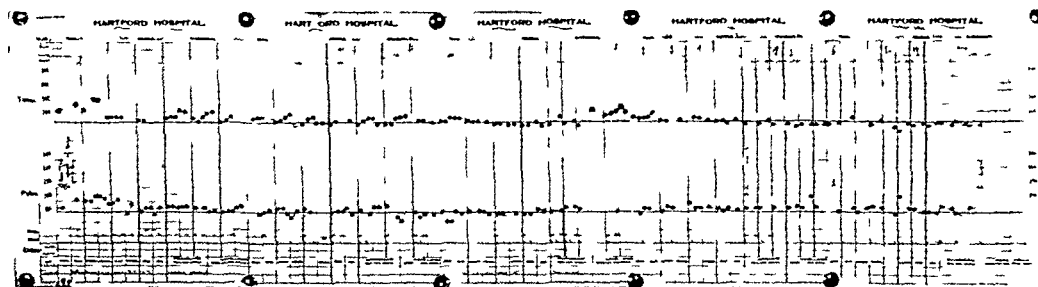


FIG 13—Temperature chart of second reported case

fever which might suggest the slightest post-operative septic absorption from the wound. This is in marked contrast with the chart of a recently reported case, where death followed six days after a comparable electric burn from sepsis and exhaustion.

Summary—Third degree electric burns are always sharply circumscribed, and the line of demarcation between the necrosed and normal tissue is as clear and distinct as it is in a case of gas bacillus infection. If the eschar is treated expectantly, it is certain that a deep slough must separate completely before the wound can heal. On the other hand, the eschar can be often resected *en bloc* and the resultant wound closed by primary suture or immediate skin graft, with great saving in suffering on the part of the patient, a material shortening of the period of immediate disability, and ultimate conservation of the functional capacity of the injured part.

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SUBCUTANEOUS STREPTOCOCCUS GANGRENE

By JOHN T. BATE, M.D.,

of LOUISVILLE, KY

IN THIS paper we wish to call attention to one type of gangrenous involvement of the vulva, rather than discuss all the local infections and systemic diseases which may result in gangrene of the vulva.

Our attention was called to this subject by a post-mortem examination performed on the body of a patient at the Louisville City Hospital.

E. G. No. 68109 female, married colored, twenty-six years of age, was admitted to the hospital February 7, 1926, complaining of vaginitis from burns caused by a douche. There is a history of profuse yellow vaginal discharge of about three weeks' duration. Upon the advice of friends a hot douche of alum and blue-stone was used one week ago. Following this, the patient was very sick and weak from pain. Instead of getting better, she has become progressively worse.

When admitted she was evidently in a serious condition.

The temperature 104.6° F, pulse 140 to the minute, and respirations 40. On the right and left sides of the lower abdomen there is much tenderness to palpation. The external vulval parts are somewhat reddened, with erythema of the adjacent skin of the thigh and lower abdomen. No pelvic examination was made. The vaginal mucosa was reddened and superficial ulcerations were present. Chest examination negative.

By the fifth day in the hospital a gangrenous area, measuring five by three centimetres, had developed in the left inguinal region. When opened a thin, purulent fluid escaped. Some small skin areas over the vulva appeared necrotic.

A blood examination made during her second day in the hospital gave: Leucocytes 16,200, polymorphonuclear cells 76 per cent, red cells 3,680,000, hæmoglobin 75 per cent.

Urine—Albumin four plus. Loaded with red cells and pus (not catheterized).

The temperature fluctuated between 104.6° F daily, tending to become lower. The day of death it varied between 102° and 97° F. She died on the tenth day after admission.

Post-mortem Report—In the left inguinal region is an ulcerated, necrotic area five centimetres in greatest diameter which exudes greenish-yellow, purulent fluid (Fig. 1).

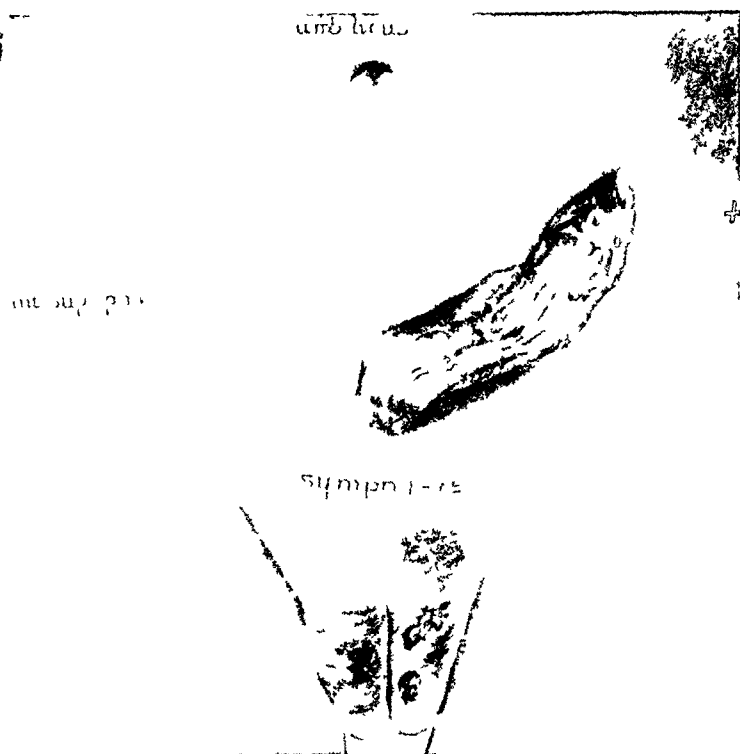


FIG. 1.—Subcutaneous streptococcus gangrene involving vulva and abdominal wall. The shaded area indicates the extent of the subcutaneous gangrene.

Vulva œdematous and necrotic Subcutaneous tissues about ulcerated area in left inguinal region are necrotic and undermined, extending to the posterior axillary line on the left, nipple line on the right, up to the level of the umbilicus and down to the pubic The necrosis does not extend through the anterior muscle sheaths, being limited to the subcutaneous tissue

Cultures and smears taken from the necrotic subcutaneous tissue showed a pure culture of streptococcus hemolyticus Unfortunately these streptococci were lost during transplantation before experiments could be performed to see whether or not they possessed a selective action on subcutaneous fat and fascia

The illustration shows the area of greenish-brown gangrenous skin, and the area over which the subcutaneous fat and connective tissue was necrotic, while the overlying skin was intact This area extended from the umbilicus to the anus There were only small areas of skin necrosis on the vulva

Etiology—During work on the wards of a large general hospital, we have seen three cases of subcutaneous gangrene The first occurred in a German, fifty-five years of age, who first presented himself with three small areas of gangrenous skin on the outer side of the right foot, outer side of the right ankle and the dorsal part of the right leg The lower third of the right leg was reddened and swollen The lymphatic glands in the popliteal space were slightly enlarged and painful There was a faint trace of albumin in the urine and the blood sugar was ninety-five milligrams per 100 cubic centimetres A culture from the wound showed a pure growth of streptococcus hemolyticus The blood culture was negative

For two months conservative treatment consisting of multiple incisions and Dakin's tubes was followed The process extended continuously following the subcutaneous tissue and the fascia between the muscles The thigh was then amputated at the juncture of lower and middle thirds Even then great difficulty was experienced in checking the infection He was finally discharged as cured 186 days after amputation

The pathological report of the examination of the amputated leg was as follows There is extensive sloughing of the skin, subcutaneous tissue and fascia between the muscles These areas have indolent margins and there is sloughing beneath the surface of the undermined skin There is no evidence of healing These areas are confluent and leave much of the muscle and bone of the calf exposed

The second case¹ was a white, American, male, forty years of age, with extensive involvement of the right arm This member was swollen to twice its normal size It was dark red in color, the brawny induration and redness extending into the tissue over the deltoid muscle On the flexor surface of the right forearm were several areas where the skin was greenish-yellow in color, due to necrosis There were a few bridges of healthy tissue separating the sloughing areas The total area measured approximately twenty-five by six centimetres

At an emergency operation performed by Dr H H M Lyle, the sloughing skin was removed, the skin edges raised and the necrotic subcutaneous tissue dissected out until living tissue was reached This neces-

SUBCUTANEOUS STREPTOCOCCUS GANGRENE

sitated raising the skin for several centimetres in all directions. Hydrogen peroxide was used to clean the denuded areas and Dakin's packs were applied. This same method was used whenever a devitalized area appeared.

Using general surgical methods, this man recovered completely with a perfectly functioning arm.

A pure culture of streptococcus hemolyticus was obtained from the wound.

The third case was that of an Italian, about fifty-five years of age, who was markedly prostrated and who presented a scrotum swollen to the size of a small grape-fruit, dark red in color with several areas of greenish-brown skin necrosis. The penis was similarly involved and the brawny redness of the skin extended onto the abdomen for a distance of twelve centimetres. A No. 22 Charrière soft catheter passed easily into the bladder. He died within twenty-four hours. The medical examiner, without seeing the body, directed that a diagnosis of erysipelas of the genitalia be assigned as the cause of death.

Meleney² has written a very thorough article describing a group of cases characterized by a rapidly developing gangrenous process from which only the hemolytic streptococcus can be recovered with regularity. Pfanner³ had previously reported such a case of gangrene of the extremity and Siemann,⁴ Hawkins,⁵ Stirling,⁶ and Campbell⁷ had described cases of this affection of the scrotum. Meleney studied seventeen cases personally and collected three cases from the records of the Union Peking Medical College Hospital. The disease usually occurred in males, probably from contact with dirt, although there was usually a history of a minor injury. In his series, the incidence was the foot, six, the leg, three, the thigh, one, the forearm, four, the arm, three, the hand, one, the chest wall, one, the penis and scrotum, one.

Clinical Course—This is alarmingly rapid. Usually within twenty-four hours after the appearance of the original lesion, the affected member becomes greatly swollen, hot, red and tender, with symptoms and signs of acute inflammation spreading rapidly. The temperature quickly increases. It may be preceded by a chill and is almost always followed by profound prostration.

The early swelling makes the skin tense, smooth and shiny. The redness is usually diffuse and gradually shades off into normal color at the margin. In a day or two, certain areas gradually turn darker, changing from red to purple and then to blue. About this time blisters begin to form in which clear, yellow fluid collects. Usually, on the fourth or fifth day the purple areas of skin become frankly gangrenous. They first become black, then greenish-yellow. From the seventh to the tenth day, the line of demarcation becomes sharply defined and the dead skin begins to separate at the margin or break in the centre, discharging pus and revealing extensive necrosis of the subcutaneous tissue. Sometimes the area of skin necrosis is very small, while the subcutaneous gangrene is very extensive.

Up to the time the dead skin separates fever continues, prostration increases from day to day

Lymphangitis is rare in this condition and in only a few cases is there any enlargement of the regional lymph glands. Occasionally, there is a phlebitis of neighboring veins. In one of Meleney's cases erysipelas was present at the site of infection and a few days after admission it developed on his face without subsequent necrosis there.

Erysipelas may arise, however, after the gangrenous process has subsided. This occurred in two cases of Meleney's series.

Pfanner reports that all of his cases began as erysipelas and that gangrene was secondary. He calls the disease "necrotizing erysipelas." He writes "The subcutaneous necrosis extends about a hand's breadth above the erysipelas. When early incisions are made to the limit of the subcutaneous necrosis, the erysipelas goes no further and the progress of the necrosis also stops."

In more severe cases, the process continues to advance rapidly until several large areas of skin have become gangrenous and the intoxication renders the patient dull, unresponsive, mentally cloudy or even delirious. About this time, pulmonary symptoms and signs denoting bronchopneumonia or lung abscesses may develop. Metastatic abscesses may appear at any point, but chiefly in the subcutaneous tissue.

Hemolytic streptococci were grown from the blood of seven to seventeen cases reported by Meleney. The blood culture was positive in three of the four fatal cases.

Stirling reported a case of gangrene of the scrotum and penis. A circumcision had been performed. This was followed by a slight infection for the relief of which the patient applied a strong solution of mercuric chloride. The next day the skin of the scrotum was dead. Within a few days the skin sloughed. A wound culture showed streptococcus pyogenes.

In the French literature several cases of scrotal and vulval gangrene, which followed the use of strong mercury bichloride douche, were reported. The bacteriological examination usually showed fusiform bacilli and spirilla, or evidence of a mixed infection. There was little tendency toward subcutaneous necrosis so these cases do not belong to the group we are reporting.

In some cases and, in the one we are reporting, it seems probable that the injury caused by the strong medication served as a starting point for the infection with this type of streptococcus, or else aggravated a lesion already existing.

Campbell reports five cases of scrotal and penile gangrene. In each instance, the disease was characterized by an abrupt, apparently spontaneous onset, a rapidly ensuing inflammation, with marked edema and subsequent necrosis of the superficial tissues of the genitals. The disease was accompanied by sepsis and prostration. Physical debility, associated with a variable degree of body filth, is usually present. The streptococcus hemolyticus was

cultured in each instance and was the probable causative agent. Campbell thinks the condition is closely related to erysipelas.

While many gangrenous lesions due to various other organisms have been described in the literature we are speaking only of streptococcus gangrene in this paper.

A search of the literature by Campbell revealed but six cases of scrotal erysipelas. In these, the onset and course of the disease coincided well with that of "idiopathic" gangrene. These cases were reported by Randall⁸. Velaton⁹ noticed a case following a slight incision of the frenum. Erysipelas of the face and arm occurred four days after the onset of the scrotal condition in one of Campbell's cases.

Prognosis—A mortality of between 20 and 25 per cent can be expected. Four of the seventeen in Meleney's series died. One of Campbell's cases died. Whiting collected ninety-three reported cases of scrotal involvement with a mortality of 23 per cent.

The Literature on Vulval Gangrene—Laussig¹⁰ writing in his monograph, Diseases of the Vulva, does not discuss streptococcus gangrene as an entity, but under erysipelas of the vulva he says: "I recall years ago seeing erysipelas of the vulva in association with an epidemic of scarlet fever and puerperal sepsis in a maternity hospital. Localized gangrene and death resulted in this case." In discussing gangrenous vulvitis or noma he says: "When found in adults, gangrenous vulvitis usually follows some virulent wound infection."

Brissaud and Sicard¹¹ report the case of a woman in good health in whom a blister appeared on the right labia majora. On the third day the pain irradiated into the vulva. There were no enlarged lymph glands in the groin. There was a serosanguineous discharge from the vulva and on the following day there were bilateral blackish sloughs. The gangrene was very rapid. The temperature was 98.4° F. On the fifth day the gangrene spread and the odor was foul. The patient died on the seventh day with a temperature of 105.8° F.

The urine had never had sugar nor albumin. The blood cultured on the fifth day, gave a pure culture of streptococci.

Lugeol¹² reported a case in which gangrene of the vulva followed erysipelas of the hands and face. A woman, thirty years of age, vigorous, healthy and happy, developed erysipelas of the face which lasted a few days and ran regularly through its various stages. She was believed to be well when she noticed that the labia majora were swollen and on each side there was a spot of gangrene. At the medical meeting where this was reported, Dupont¹³ reported a case of a young woman, who had gangrene of the vulva at the termination of erysipelas of the face.

The editor of the journal, in which the above was reported, refers to an article in the "Dictionnaire de Chirurgie Pratique" where gangrene, at the site of the erysipelas, was noted in very severe cases.

Since writing this article, Fallon¹⁴ has reported a case of streptococcus subcutaneous gangrene involving the breast.

Discussion—From our observation upon two living cases of involvement of the extremity, one of the scrotum and the one post-mortem examination of the case of gangrene of areas of the vulva and the subcutaneous tissue of the abdominal wall, and from our study of the literature, we believe that

one is justified in concluding that there is a type of infection which is caused by a streptococcus which has a definite predilection for attacking the subcutaneous fat and fascia. There have been frequent observations by various competent observers that there is a relation between this type of infection and erysipelas. Erysipelas has been observed to accompany the streptococcus gangrene, to precede it and to follow it.

Three cases of gangrene of the vulva from which the streptococcus has been isolated have been reported in the French literature.

This report is being made to draw attention to our belief that the same type of infection reported by others as affecting the extremities and scrotum, may also involve the vulva and extend to the abdominal wall.

Treatment—Palliative treatment must be followed until a gangrenous area appears. Then it is necessary to dissect away all of the dead tissues. When the subcutaneous tissues are necrotic beyond the limit of the superficial gangrene, the incision must be extended until the necrotic tissues are excised. When possible, the incision should not extend into the zone of cellulitis. However, the subcutaneous veins should be spared, as they are usually not thrombosed and supply areas of living skin. Hydrogen peroxide aids in cleaning away the pus and débris and also tends to stop the oozing of blood. Dakin's solution is used to dress the exposed areas.

As the wound becomes clean, the healthy granulation will fill in, the undermined skin will become attached and skin grafting can be resorted to where necessary.

Meleney recommends hot applications with water or normal saline, 40° to 45° C (104° to 107° F). After the cellulitis has disappeared, he advises Dakin's solution. He does not wait until the wound is free from streptococci before grafting skin. When the epithelium at the edges of the wound begins to grow, the wound is ready for graft.

Antistreptococcus serum was not used in Meleney's nor Campbell's series. Since then, great progress has been made by Simmers and Lewis¹⁴ working at Bellevue Hospital with a serum made, according to the method of Birkhaug, from streptococci isolated from erysipelas cases. The mortality from erysipelas at that institution has been reduced from 12.1 to 5.3 per cent. It is obvious, therefore, that it is important for other observers to endeavor to ascertain whether or not there is a definite and constant relationship between streptococcus gangrene and erysipelas. A therapeutic test with the serum would be interesting.

I wish to thank Dr. Henry H. M. Lyle, of St. Luke's Hospital, New York City, for permission to mention the cases from his service at St. Luke's Hospital, and Dr. Charles W. Hibbitt, Chief Surgeon of the Gynecological Department, Louisville City Hospital, for permission to report the case from his service. I have used freely Dr. F. L. Meleney's description of the course of subcutaneous gangrene caused by the streptococcus.

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TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

STATED MEETING HELD OCTOBER 9, 1929

The President, DR EDWIN BEER, in the Chair

ACUTE PERFORATED ULCER OF THE STOMACH

DR PAUL DINEEN presented a woman forty-five years of age who was admitted to New York Hospital March 14, 1924, complaining of acute abdominal pain of four hours' duration. She exhibited a scaphoid abdomen and was tossing about with severe epigastric distress.

An immediate operation was done and on opening the peritoneum much gas and fluid escaped. A large ulcer with a perforation one-quarter inch in diameter, and an area of induration of one inch in all directions was encountered two inches proximal to the pyloric vein and near the greater curvature. Simple closure of the ulcer was done. She made an uneventful recovery and left the hospital in sixteen days.

She still has occasional attacks of severe epigastric pain. X-ray examination reveals pylorospasm at these times. On questioning the patient it is found that these attacks are associated with some nervous upset, financial troubles or troubles with her family. As soon as her worries are removed her gastric condition is satisfactory.

Dr Dineen also presented a man, twenty-eight years of age, who was admitted to the New York Hospital August 16, 1922, complaining of an acute, agonizing epigastric pain of three hours' duration. He was a thin, anæmic individual writhing in pain with a board-like, scaphoid abdomen. White cells were 19,600 with 86 per cent polymorphonuclears. Urine negative. He was immediately taken to the operating room and a high right rectus incision was done. A small perforation, one-eighth of an inch in diameter, was found on the anterior surface of the duodenum, just distal to the pyloric vein. Simple inversion was done. Twelve days after operation he developed a most extensive ischiorectal abscess consequent to a fistula in ano. The abscess burrowed down the whole posterior aspect of the thigh and part of the leg. This abscess was opened widely. The man left the hospital ten weeks after entering. Since leaving the hospital he has occasional attacks of pylorospasm when he is overworked. Fluoroscopic examination at these times shows evidence of severe spasm that subsides in a day or two and then examination of the stomach and duodenum fails to reveal any lesion.

RESTORATION OF THE LOWER LIP AND PORTION OF CHIN

DR WILLIAM F MACFEE said that a number of methods are available for restoration of the lower lip. In most of these methods, use is made of

RESTORATION OF LIP AND CHIN

the adjacent tissues of the face and neck, usually as flaps, to replace the missing lip. He presented two cases in which the extensive destruction of tissues or previous scarring, made such methods impracticable. Recourse was made, therefore, to the tissues of the anterior chest wall.

The first case was a male, fifty-two years old, who was admitted to St Luke's Hospital, May 2, 1926.

History—About fifteen years ago he first noticed a small elevated "spot" on the right side of the chin. It was frequently cut in shaving, and alternately was ulcerated and healed. No increase in size was noticed, but the patient became fearful that it might become cancerous and decided to have



Figs. 1 and 2—Appearance of patient after sloughing was complete. In the lateral view what appears at first glance to be the lower lip is really the tongue. Lower lip and gingiva are completely absent. A thin portion of mandible remains. Outline of flap is shown.

treatment. Between 1921 and 1925 four radium treatments were administered in another hospital. After the first treatment the lesion remained healed for thirteen months, then ulcerated again. After a second treatment it remained healed for six months. The third treatment was with a radium pack. Following this healing again resulted, but recurrence followed two months afterward. A "stronger" treatment was then given with the radium. This caused a mass of sores to form, first on the inside and then on the outside of the lip. Eight weeks were required for healing of the initial lesion and these sores. Nine weeks after healing the growth returned. The patient did nothing more for some time. He then consulted another doctor who told him he had cancer all over his lip, chin, and gums, and advised the

use of a paste The doctor and a young man who provided the remedy came to the patient's house and applied the paste to his lip and chin, this being about five months after the last radium treatment The paste was left on for twenty-four hours, and then "slippery elm poultices" were applied every two hours for six days After removal of the cancer paste the lip and chin became "as hard as cement" The slippery elm poultices caused the area to crack and to begin to separate from the good flesh Within a few days the tissues in the vicinity of the initial lesion came away, leaving the bone exposed The doctor and the young man then saw more cancer under the edges of the skin and more paste was applied The entire lower lip and adjacent structures sloughed away

Examination—The entire lower lip and the soft parts of the chin are missing, and the mandibular symphysis is exposed (Fig 1) The gingiva has likewise been destroyed, and only a narrow stretch of tissue exists between the tongue and the posterior surface of the mandible at the point Saliva drools freely from the mouth as the patient tries to retain it by pressing his tongue against the upper lip The surface of the exposed bone is black and necrotic, but does not separate easily from the portion of bone which is still nourished No evidence of cancer is seen in the wound edges, and nothing suggestive of cancerous lymph nodes is felt in the neck

May 12, 1926, the necrotic bone was removed

May 26, 1926, an arcuate incision was made on the anterior chest wall, beginning near the junction of the medial and middle thirds of the right clavicle, extending downward at its lowest point to the level of the third rib, and then ascending to a point on the left clavicle corresponding with that on the right A second incision parallel to the first was made three inches below the first Both incisions were carried down to the underlying muscle (Fig 2) The central eight inches of the

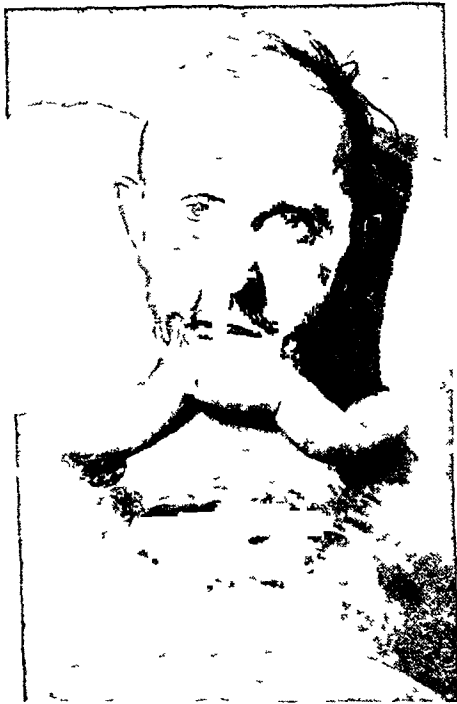


FIG 3—Flap with double pedicle is shown attached to chin Some separation has occurred at the angles The mucous membrane of the new lip is seen in the upper central portion of the flap

flap, thus outlined, were elevated from the muscle and sternum The underlying portion of the right pectoralis major muscle was divided transversely to its fibres, at a distance of three inches from the sternal origin The left pectoralis major was cut in a similar manner The muscle flaps, thus formed on either side, were then turned medially and sutured together in the mid-line over the sternum, in order to form a fleshy prominence which should serve as a new chin The incisions were closed with silk

July 1, 1926, the incisions were opened up, and a wider portion of the tentative flap was freed from the chest wall The upper edge of the central portion was shaped to correspond as nearly as possible to the shape of the lower lip The patient was then circumcised and the preputial mucous membrane was used as a full thickness graft to form the inner surface of the lip This part of the procedure was suggested by previous work of Dr Franz

RESTORATION OF LIP AND CHIN

lorek and Dr. H. H. M. Lyle. After the graft of mucous membrane had been sutured in place, the entire flap was returned to the chest wall.

July 14, 1926, the flap was freed completely from the chest wall, except at its two pedicles near the clavicles. The mucous membrane had taken well. It seemed safer not to attempt a transfer of the flap at this time. After minor adjustments, it was again replaced and sutured to the chest.

July 23, 1926, after the margins of the facial defect had been prepared to receive it, the graft was transferred from the chest wall to the chin and sutured in position. Both pedicles were left attached at the clavicles (Fig. 3). The open wound left on the chest was covered with a Thiersch graft.



FIGS. 4 and 5.—Present appearance of patient in natural pose. The lips which are held slightly parted can be completely closed.

August 6, 1926, the right half of the flap was divided at the outer margin of the facial defect. It was necessary to ligate both ends of a severed artery running in the flap. The lateral portion of the flap was returned to the chest wall. No attempt was made to revise the amputated portion attached to the chin.

August 18, 1926, the left half of the flap was divided. Several small vessels had to be ligated. The portion of the flap remaining was placed in its original position on the chest wall.

August 25, 1926, the raw ends of the graft were shaped and fitted into the facial defect.

September 22, 1926, patient was allowed home for a rest.

October 5, 1926, the patient returned to the hospital to have corrected a drooping of the lower lip, which prevented complete closure of the mouth. At the suggestion of Dr H H M Lyle, a strip of fascia was passed from the thigh transversely through the lip and its ends anchored in the upper, remaining portion of the orbicularis oris at the insertions of the caninus, zygomaticus, and buccinator muscles. This made possible an active, complete closure of the mouth.

May 4, 1927, on account of a remaining tendency of the lower lip to droop and to evert, a second strip of fascia was inserted in the lip and anchored as before, except that it was drawn more tightly. Considerable improvement resulted.

January 13, 1928, a triangular wedge of skin and tissue was removed from the lower portion of the chin to give a better silhouette. Figures 4 and 5 show the ultimate result of this work.

The second case was a man, fifty-eight years of age, who was admitted to The New York Skin and Cancer Hospital March 26, 1927, with a history that he had been originally operated upon March 22, 1926, in another hospital. At that time, the lower lip was completely removed with the cautery for an extensive squamous-celled carcinoma. No attempt had been made to restore the lip. Previous to removal of the lip, he had had three radium treatments, September 17, October 1, and November 1, 1926.

Examination — The patient has a healed scar

FIG 6—Appearance of patient after flap for lip reconstruction had been outlined on chest. A single pedicle was used in this case.

resulting from complete removal of the lower lip. The skin of the chin below is united to the gingival mucous membrane. In the left submaxillary region, there is a hard lymph node two centimetres in diameter and about two and one-half centimetres below the skin surface. It does not seem fixed.

The patient was first operated upon by another member of the attending staff on March 31, 1927. Incisions were made at each angle of the mouth and carried laterally for a distance of about three centimetres. A curved incision was then carried from the lateral end of each incision downward to the mandible. The two flaps thus formed were swung forward and medially, and were united in the mid-line to form a new lip. Because of severe infection, the flaps separated and the operation did not succeed. The result is seen in the first photograph.

The presence of scars in the cheeks precluded their use for further

RESTORATION OF LIP AND CHIN

attempts at cheiloplasty. The tissues of the neck were likewise undesirable material because of the possible presence of carcinomatous metastases, and because of the additional scarring which would result. A thoracic flap was therefore chosen. Before attempting to restore the lip, however, it seemed advisable to remove the lymph nodes from the left anterior cervical triangle, where a good-sized node was palpable. This was done April 27, 1927. The lymph node which had been palpable showed squamous-celled carcinoma with pearl formation and central necrosis.

Second operation, July 11, 1927. At this time, a flap was outlined on the chest wall in such a manner that its free end could be shifted to replace the lower lip. The pedicle was placed near the middle of the right clavicle. The incision was made to the depth of the pectoralis major muscle. Its medial half was completely elevated from the chest and was shaped to form



FIG 7—Shows flap attached to chin

FIG 8—Appearance of patient after restoration, lateral view. The irregularity seen at the junction of graft with skin of chin has since been removed

a new lower lip. Skin taken from the back of the right ear was used as a full thickness graft to serve as mucous membrane for the lip. After this was secured in place, the flap was returned to the chest wall and sutured there, to await development of better circulation before an attempt should be made to transfer it.

Third operation, July 25, 1927. The flap was completely freed except its pedicle. The graft from the back of the ear had adhered and the color of the flap was good. The chin was prepared to receive it, and the transfer was made. The mucous membrane of the new lip was sutured to that of the gingiva and the cheeks. The skin defect on the chest wall was covered by a Thiersch graft, taken from the thigh.

Fourth operation, August 19, 1927. The circulation of the grafted portion of flap was tested by compressing the pedicle. It seemed adequate and the flap was amputated at the right lateral margin of the labial defect. This

free end of the graft was fitted into the defect and sutured there. The remaining portion of the flap was returned to the chest.

Fifth operation September 23, 1927, consisted of removal by dissection of the supraclavicular lymph nodes on the left side. A large adenoma of the left lobe of the thyroid gland was removed at the same operation.

Sixth operation November 8, 1927. Removal by dissection of the lymph nodes of the right anterior triangle of the neck.

Seventh operation June 21, 1928. Revision of grafted lip to make it fit evenly with the chin surface.



FIG. 9.—Appearance after restoration, front view.

DR. FLN WICK BELKMAN referred to a patient he had treated at Bellevue Hospital two years previous. A boy in an automobile accident had had his lower lip and soft tissues of the chin avulsed and a fracture of the symphysis of the jaw. A local physician had carefully debrided the wounds removing all the lacerated tissues. Consequently there was nothing left of the lower lip or the soft parts about the chin. The patient was admitted to Bellevue Hospital ten days after the accident. At that time the bone of the jaw was exposed. After consultation with the dental

surgeons the teeth were wired until the fracture had healed. The new soft tissues of the chin were reconstructed from lateral flaps, the mouth being widened by incisions on each side and the mucous membrane sewed to the skin. A well-fashioned lip was formed following the first operation, but there was a fistula beneath it. Six months later this was operated on and closed.

Doctor Beekman made a plea in speaking of these cases, against the debridement of wounds of the face. The tissues of the face are so very vascular that it is not necessary and for future plastic work, no part should be needlessly sacrificed. Instead, any ragged tissue should be brought as far as possible into its normal position and allowed to heal, thus favoring a later plastic repair.

DR. HUGH AUCHINCLOSS had noted that these cases demonstrated per-

MULTIPLE SPONTANEOUS FRACTURES

rectly the painstaking care necessary in dealing with these conditions. His own experience had been confined to restoration of contractures following burns and he had accomplished this by the use of flaps from neighboring parts, from the cheeks or from the arm in the deltoid region. He had carried flaps from the lower chest and abdominal wall by stages towards the neck and then grafted them to the contracted area.

DOCTOR MACFEL in closing, said that as compared with those from the arm, chest flaps have the advantage of allowing the patient more mobility. These operations are done over several periods and when using chest flaps the patients are able to be up and about the ward in the intervals. This adds considerably to their comfort and insures more willing cooperation from them.

MULTIPLE SPONTANEOUS FRACTURES

DR CLAY RAY MURRAY presented a man with the following history. He was admitted to the Medical Service of The Presbyterian Hospital for the first time May 1, 1928, on account of rheumatism of fourteen months' duration. Six years ago he began to have pain and vomiting during and after meals. Describes pain as epigastric and pressing in character. Continued for two years, when after a sudden and more severe attack he was taken to a private hospital in Chicago and subjected to an emergency operation for perforated gastric ulcer. Was told that a piece of intestine had been removed. Since then has had relief from gastric symptoms. Pain, vomiting, and attendant loss of weight had been the only symptoms. While in the hospital following operation it was noted that he had ocular pupillary changes and a blood Wassermann was done which was negative. Wassermann at Neurological Institute negative about two years ago. Spinal puncture advised and refused. Is extremely "nervous." Has had occasional attacks of dizziness. Suffers from insomnia. Denies lues. Has had intermittent diarrhoea with incontinence for four years, relieved by courses of enemata.

Present illness—Fourteen months before admission left ankle became swollen. Joint was hot and tender and patient felt feverish for a few days. In subsequent attacks other ankle and both knees were involved. Intervals between recurrent attacks became progressively shorter. Was treated by mouth medication and physiotherapy, and all teeth were extracted without relief. Some loss of weight and night sweats. Attacks of diarrhoea and incontinence in last seven months relieved by enemata. Seven months ago began to have constant difficulty in walking, and had to quit work. Legs felt "heavy as lead," feet dragged, and he kicked steps when walking up them and stumbled. No difference noted in the dark. For three months there has been pain across lower lumbar region and across the chest. No change in visual acuity. No gastric or urinary symptoms. No history of injury of any sort at any time.

On admission the positive physical findings were inequality of the pupils, right smaller than left, with very sluggish reaction to light, more marked right than left, markedly exaggerated but equal knee jerks, spleen palpable, and liver four centimetres below costal margin, left ankle uniformly swollen, slightly tender, not red or hot, without impairment of motion range, moderate abnormal bony prominence on os calcis below internal malleolus, dulness both apices with harsh breathing and few râles over the left apex, slight swelling of right knee, not tender, no limitation of function, no fluid in the joint. Neurological examination revealed in addition to the pupillary changes some emotional instability and memory impairment, and some impairment

of pain and temperature sense in the legs, but was otherwise negative Wassermann repeatedly negative Spinal fluid was serologically negative, and showed no abnormality in cell content on two occasions Temperature was normal Red blood cells 4,340,000, hemoglobin 88 per cent, white blood cells 12,500, with normal differential Chest X-ray negative X-ray of the head showed some clouding of the sinuses, but was otherwise negative There was some periostitis of the outer margins of both fibulae, and of the inner margin of the right tibia Gastro-intestinal series was negative for any evidence of pathology or of the existence of a gastro-enterostomy or other abnormality There was a transverse fracture of the right fibula six centimetres below the upper end There was in the left os calcis an oblique fracture with considerable bone production This extended from the upper margin just posterior to the joint margin downward and forward through the mid-plantar margin of the bone The joint margins were smooth The process was apparently of some duration These fractures accounted for the knee and ankle symptoms There was no history of trauma The medical staff and the neurologists felt that the story was one of central nervous system lues despite the sparse neurological findings and the negative blood and serology findings His fractures were considered as pathological and as part of the recognized possibilities in tabes and spinal lues His fractures were treated by protection by a brace, and he was put on antiluetic treatment with very marked improvement in his symptomatology

On the 2nd of October X-ray reported firm union in the fractures and discovered a fracture of the base of the second metatarsal, healed At this time he was walking with the short brace without a cane, and to use his own words, felt fine, had no pain, and the foot and knee were normal

On October 15, 1928, fifteen days after the preceding note was recorded he was admitted to the Fracture Service at the Hospital with the following story While climbing the stairs carrying a suitcase he heard a snapping sound in the leg which he attributed to the brace he was wearing He felt no pain or discomfort in the leg Two or three hours later while resting in his room he began to have pain in the anterior part of his right thigh This continued all day He took a hot bath and applied oil of wintergreen Noted no deformity or abnormality in the thigh Pain was increased by walking and flexion of the thigh Had to use a cane The pain was worse the next morning and the patient went to bed where he stayed till admission On afternoon of day of admission patient limped to bathroom in his home The door bell rang and startled him, and he put his whole weight suddenly on his right foot He immediately felt a severe pain in his right thigh, and a large swelling appeared He supported himself by the nearest piece of furniture and by pressure caused the swelling to disappear He got to bed, was seen by a local doctor, and sent to the hospital

X-ray showed a fracture of the middle third of the shaft of the right femur with deformity This was treated by traction suspension followed by a plaster spica, both of which the patient bore badly, and later with a walking caliper, which the patient removed early against advice The course was characterized by a very slow union Blood Wassermanns were again negative Patient refused spinal puncture Neurological consultation resulted in the same opinion as on previous admission Antiluetic treatment resulted in no effect on the course of fracture healing that could be determined The administration of calcium and irradiated ergosterol by mouth had no observable effect on the calcification process, nor on the blood phosphorus and calcium, which were normal throughout his course All the long bones and skull were negative on X-ray On the 2nd of January, 1929, the spica was

SUPRACONDYLAR FRACTURE OF HUMERUS

removed and a walking caliper applied. On March 8 the patient was going about without the caliper because of his business needs, driving a car. X-ray at this time showed a large amount of callus spread diffusely through the tissues with decalcification of the shaft margins. There was considerable deformity due in part, at least, to the discarding of his brace at too early a date.

He was next admitted to the Fracture Service of the Hospital on July 3 of this year. While walking along the street he felt the left thigh snap, and immediately collapsed. Admission X-ray showed a spiral fracture of the upper third of the left femur. There was considerable displacement with one and a half inches overriding. He was again treated by traction suspension. Blood calcium and blood phosphorus have been normal. On September 5 it was noted by X-ray that there was no callus and that the shaft of the femur appeared porotic and that the cortices were thinned. A few days ago it was noted that although the X-ray of October 27 noted the appearance of only a very slight amount of callus at the bone ends, clinically the union felt fairly firm. He was therefore fitted with a caliper, and is to be allowed to walk as soon as the opposite shoe is raised to allow of locomotion.

This case is shown not as a result of fracture treatment, but because of its peculiar features of excessive fragility of the bones, relative painlessness of injury and course, normal blood chemistry, normal serology, and scant neurological findings. In addition the problem has to be faced as to how further similar catastrophes can be avoided if that be possible.

FIG. 10

FIG. 11



FIG. 10—Anterior posterior view of supracondylar fracture showing displacement of lower fragment.

FIG. 11—Lateral view one month following injury. Note callus formation in the periosteal tube and the obstruction to complete flexion by the lower end of the upper fragment.

SUPRACONDYLAR FRACTURE OF THE HUMERUS

DR FENWICK BEEKMAN said that at the joint meeting of the New York Surgical Society and the Philadelphia Academy of Surgery in Philadelphia in 1926, Dr DeForest Willard presented a boy who had sustained a supracondylar fracture of his humerus, the lower fragment being displaced posteriorly and upward. Union had occurred without the deformity being corrected, a new shaft of the lower fourth of the humerus being formed within the periosteal tube which had been stripped off the lower end of the upper fragment and later, this portion of the original shaft had become absorbed, so that at the time the patient was presented, there was no deformity or interference with the function of the elbow.

The patient whom Doctor Beekman presented showed a similar condition. He was a boy who, at the time of the accident, May 7, 1927, was ten years of age. He had fallen, striking his left elbow upon the sidewalk, and

sustained a supracondylar fracture of the left humerus. The fracture line was transverse and the lower fragment was displaced backward and upward (Fig 10). Because of the swelling of the soft tissue, immediate reduction and immobilization was thought to be inadvisable and the limb was suspended by adhesive straps applied to the forearm. Later, it was found impossible to fix the lower fragments.

In three weeks' time, it was noted that both flexion and extension at the elbow joint were much limited and that supination and pronation of the forearm were normal.

A roentgenogram of the elbow secured four weeks after the accident, showed new bone formation in the periosteal tube (Fig 11).

Two months following the injury, full flexion was limited to ninety degrees and extension to one hundred and fifty degrees and the X-ray showed that the old shaft blocked further flexion of the elbow by impinging upon the coronoid process of the ulna (Fig 12). A year later the elbow had motion of eighty degrees flexion and extension less ten degrees of the normal.

FIG 12

FIG 13



FIG 12—Same as view in Fig 2 six weeks following the injury. End of upper fragment is becoming rounded off by absorption of the bone.

FIG 13—Two years following injury. Flexion not obstructed. End of upper fragment which formed bony block absorbed.

At this date the function is found to have increased, so that extension is normal in range and flexion is but slightly limited, the forearm being carried to a position forming an angle of thirty-five degrees with the arm. There is no anatomical deformity and the X-ray shows that the bony block caused by the distal end of the upper fragment has disappeared, that portion of the original shaft having been absorbed (Fig 13). Thus a year passed before the bone producing the block commenced to absorb.

Fractures about the elbow joint in adults in which complete reduction has not been obtained will invariably produce functional disturbances, but not so in the child. It is surprising to observe the results of injuries of the lower end of the humerus in which it has been impossible to obtain a satisfactory reduction as the majority of these patients attain normal function.

This case is presented as a plea for conservative treatment in caring for fractures about the elbow in children. The writer has seen patients with less deformity operated upon and in one instance osteomyelitis followed an infection of the wound producing a marked limitation of motion in the joint. In the growing individual nature tends to overcome deformities, consequently we must bear this in mind and treat such cases conservatively.

DR CHARLES L. FARR considered this to be an excellent result. He agreed with Doctor Beekman that it was wiser to leave these cases alone as

ENTEROGENOUS CYST OF ASCENDING COLON

a rule, but occasionally this policy was followed in later years by very bad results and he wondered if there were special indications when to and when not to interfere

DOCTOR BELKMAN rejoined that it was common to see adults with deformity resulting from fracture in childhood but it was difficult to disclose the type of intercondylar fracture they had had. The speaker had a patient with a fracture of the elbow in which the fragments had been displaced respectively, laterally and medially. The child now has a deformity although there is full motion.

ENTEROGENOUS CYST OF ASCENDING COLON

DR FLEWICK BELKMAN presented a girl who had been admitted to the Children's Surgical Service of Bellevue Hospital November 15, 1927. She was five and a half years of age. She had always been well until the twenty-four hours before admission to the hospital when she was suddenly taken ill, complaining of a clamp-like pain which centered in the right lower quadrant of the abdomen. She could not sleep and she vomited several times. These symptoms continued until the time of admission to the ward. Her bowels had moved the day before and during the morning of the day of admission. She had passed no mucus or blood by rectum. She described the pain as being around and to the right of the umbilicus. Her temperature was one hundred and six-tenths and pulse one hundred and thirty-four. The leucocyte count was eleven thousand with a differential count of seventy per cent polymorphonuclear leucocytes.

The abdomen, on examination, was found to be soft, the anterior wall retracted and there was no tenderness to palpation. Active waves of peristalsis could be seen and on palpation, a freely movable slightly tender, sausage-shaped mass was felt in the right lower quadrant. This appeared to be the size of a hen's egg and moved with the respiratory movements. During the twenty-four hours that the patient was observed, while in the hospital, her condition did not change. There was no further vomiting and the bowels moved again after an enema had been given.

The pre-operative diagnosis was a partial intestinal obstruction, the probabilities of it being an intussusception. The patient was operated upon twenty-four hours after admission, under ether anaesthesia. The abdomen was opened by a three-inch incision through the right rectus muscle at the level of the umbilicus. The terminal ileum was found slightly distended and a mass about three to four centimetres in diameter was found situated in the angle between the terminal ileum and the ascending colon. It was so placed that it pressed upon the wall of the ileum just proximal to the ileocaecal valve. It was round, freely movable and covered with healthy looking peritoneum. On palpation, it gave the sense of containing fluid. It appeared to be situated in the mesial wall of the ascending colon. The peritoneum over this mass was incised and an attempt was made to enucleate it. In doing this the cyst ruptured, the contents being a thick, glairy mucus of a slightly yellow color. The lining of the cyst was apparently normal intestinal mucous membrane which contained no folds. Except for the mucous membrane and the serosa, there were no other layers to the wall of the cyst. As the condition of the patient was not particularly good, the edges of the wall of the cyst were sutured to the edges of the parietal peritoneum. Just as this procedure was finished, the child commenced to strain violently under its anaesthetic and a

small amount of faecal material was forced from the colon through a small opening into the cyst

Two days following the operation, the wound was dressed and faecal material was found coming from the wound. A faecal fistula became established which failed to close spontaneously

June 15, 1928, seven months after admission, the child was again anaesthetized and an elliptical incision was made about the mouth of the fistula and the skin edges of this flap were closed over it. The abdomen was entered just mesial to the tract of the fistula. The intestinal wall was clamped proximal to the opening of the fistula and the tract was divided with a cautery. The opening in the gut was closed with two rows of sutures, its edges being invaginated. The abdominal wall was closed about a cigarette drain. The child made an uneventful recovery and was discharged from the hospital August 9, 1928, and since then has been well

DOCTOR BEEKMAN remarked that enterogenous cysts arise in a similar manner to congenital diverticulæ of the intestines. A few may be due to the obstruction of the opening into the intestine of a congenital diverticulum, a retention cyst. Enterogenous cysts and congenital diverticulæ result from the growth of a prolongation of the lining epithelium of the intestine, in the embryo, into the mesenchyme, where it becomes vacuolated. If this prolongation of cells into the mesenchyme remains connected to the lining epithelium of the intestines, a diverticulum is formed. If the group of cells becomes isolated in the mesenchyme, they produce a cyst. Enterogenous cysts may lie beneath the mucosa, the serosa or even isolated between layers of the mesentery. These cysts contain elements of the intestine, whether they lie in its wall or free in the mesentery and should be differentiated from those due to other causes, as the ones developing from the Wolffian body and dermoid, parasitic and malignant cysts

The wall of an enterogenous cyst always consists of mucosa and may or may not have a muscular or serous layer. Its contents are due to the secretion from the cells and are of a mucilaginous character

Congenital diverticulæ and enterogenous cysts may be situated at any point in the intestinal tract. Diverticulæ are particularly common in the upper portion, especially the duodenum. The cysts are more often situated about the cæcum and proximal part of the ascending colon

Clinically, the cyst is often first discovered by producing symptoms of intestinal obstruction due to mechanical pressure, a volvulus or intussusception. Occasionally they grow to enormous size

An article on this subject with an exhaustive study of the literature has recently been published in the British Journal of Surgery (vol xvii, 1929) by Arthur Evans, of Westminster Hospital, London

ACUTE PERFORATED ULCERS OF THE STOMACH AND DUODENUM

DR PAUL DINEEN read a paper with the above title for which see page 1027

DR JOHN A McCREERY said that his experiences at Bellevue Hospital had very closely paralleled the results shown by Doctor Dineen. He appreci-

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ciated particularly the emphasis that was placed on the value of the follow-up, not only with regard to the physical condition, but also the mental and moral examination which Doctor Dineen summed up in the word "coaching." Alcohol had been more of a factor in the cases coming to Bellevue than in those presented, many of the Bellevue cases giving a history of a few days to a week prolonged alcoholic excess immediately preceding the perforation. In about 10 per cent of the cases the perforation came out of a clear sky as the first symptom of ulcer, the remaining cases having histories suggestive of ulcer varying in duration from weeks to years.

As regards procedure, without question the first and most important is immediate operation and closure of the perforation, but Doctor McCreery did not agree that nothing more should be done in any case, as it seemed to him that if one felt that gastro-enterostomy should be done for the cure of duodenal ulcer there were certain cases of perforated ulcer in which it was indicated. These seemed to him to be the cases in which there was a more or less extensive area of induration about the perforation, suggesting that a considerable amount of diseased tissue was still present, while in other cases in which one found an apparently normal duodenal wall about the perforation—in other words, complete destruction of the disease by the accident—closure alone was all that was necessary. Operative obstruction is rarely a reason for gastro-enterostomy as this type of obstruction usually disappears very rapidly. On the First Division at Bellevue Hospital 30 per cent of the cases of perforated duodenal ulcer had an immediate gastro-enterostomy done, as opposed to 10 per cent of the gastric ulcers. In the latter it was done because of the feeling of the operator that there had been interference with the lumen of the intestine. Following these indications, secondary operation had been necessary in only four cases. In one a gastro-enterostomy was done for recurrence of a duodenal ulcer after eight months. In three a partial gastrectomy was done for recurrence of a gastric ulcer.

Recent foreign literature has emphasized the possibility or advisability of resection in these cases. Doctor McCreery felt that indications for such a procedure with a contaminated peritoneum were very rare. One such operation had been done on his service in a case in which satisfactory closure of a large perforation had been impossible because of extensive induration. The result had been satisfactory but the procedure should, with very rare exceptions, be condemned.

DR RICHARD LEWISOHN remarked that Doctor Dineen had said that many patients needed to observe a strict diet over a long period. It is fair to assume that a number of such patients are still suffering from a chronic ulcer. The opinion that perforation cures an ulcer in practically every case is certainly erroneous. One of the methods of treating chronic duodenal ulcer by cautery-puncture is based on this idea. It is very evident that a great many cases with ulceration of the wall of the duodenum cannot really be cured by an acute perforation, for in many cases one is dealing with a

double ulcer one in the anterior and one in the posterior wall of the duodenum. The ulcer on the anterior wall perforates and is closed by suture, the ulcer on the posterior wall, however, continues to give symptoms.

The statistics of acute perforated ulcers, operated on during the years 1915 to 1925 at Mount Sinai Hospital, have been published by Doctor Stenbuck. Doctor Lewisohn stated that he had seen these patients in 1927 in order to find out how many of the cases were perfectly well. On re-examination, which was done very carefully by questioning the patient, giving test meals, taking X-rays etc., it was found that a great many of them had symptoms of persistent ulcer. X-rays showed retention pockets in the duodenum and tenderness on pressure, proving that the ulcerative process was still going on. Doctor Dineen had mentioned pyloric spasm which he attributed to nervous upsets. On careful examination, this symptom might be found to be due to a persistent ulcer.

Referring to Doctor Dineen's report of twenty per cent of absolute failures or incomplete cures Doctor Lewisohn said that in the Mount Sinai statistics there were thirty-nine per cent failures. That leads to the question whether one should not attempt more radical work at the time of operation. In Germany and Austria surgeons performed partial gastrectomy as the primary operation but the speaker believed that in the acute stage these cases should not be subjected to any radical procedure. He believed it wiser to do as little as possible during the acute stage and observe the patients carefully for six months. Then, if ulcer symptoms were still present or if they suffered from seasonal attacks these patients should be subjected to partial or sub-total gastrectomy. The speaker stated that unquestionably many of these patients are not permanently cured and that the acute perforation failed to cure the ulcer in a large number of cases.

DR J WILLIAM HINTON asked Doctor Dineen whether he distinguished between gastric and duodenal ulcer. He was in agreement as to simple closure giving good results. In the Gastro-Intestinal Clinic at Bellevue Hospital 201 cases of ulcers were under observation. In that group 164 were duodenal twenty-seven with acute perforation, of these, seventeen had simple closure, seven pyloroplasty of the Horsley type, and three had closure plus gastro-enterostomy. It is interesting to note that of the duodenal ulcer group five perforated while under medical treatment in the clinic, four of these cases never had surgery performed, and one had had an acute perforation and recurrence of symptoms. In this series thirteen were diagnosed by the operating surgeon as perforated gastric ulcer. Of that group nine have been re-X-rayed and all had definite duodenal lesions, none had any evidence of gastric lesions. Two were too recent to re-examine and two failed to return for X-ray examination. In following these nine cases it was found that four needed subsequent surgery three for scar tissue obstruction of the pylorus, one patient had gone five and one-half years following the first operation and the shortest case ten months.

PERFORATED ULCERS OF THE STOMACH AND DUODENUM

Doctor Dineen had stressed the fact that these patients have symptoms if not properly followed and in the Bellevue group there were five cases that had been operated on in other hospitals in this city, one case having been symptom-free for fifteen years before returning for treatment, the other cases ten, seven, six and five years.

DR CHARLES E. FARR reported the data for perforated gastric and duodenal ulcers from the First Surgical or Cornell Division of the New York Hospital, service of Doctor Gibson.

Total number of cases was 139 of which eighty were duodenal and fifty-nine were gastric. One hundred and thirty-three were males, six were females.

The total operative mortality was 17.9 per cent.

The number of cases within the twelve-hour period was 110, and within the eighteen-hour-period, five. In this series there were fourteen deaths or 12.1 per cent mortality.

In the next six-hour period, from eighteen to twenty-four hours, there were nine cases with two deaths or 22.2 per cent mortality. All cases over twenty-four hours in duration numbered fifteen, with nine deaths, the mortality being 60 per cent.

It is interesting to note how closely these figures resemble those given by Doctor Dineen. This makes a total number of cases from the New York Hospital of 281 giving a mortality percentage of almost exactly 20 per cent.

Their treatment of these cases is very closely similar to that of Doctor Dineen's and the end-results closely approximate his. They are possibly a little more opposed to primary gastro-enterostomy—First, because it is exceedingly difficult to be sure that the gastro-enterostomy is needed. Second, because there is a definite mortality for gastro-enterostomies in the hands of even the most expert surgeon. Third, the results of gastro-enterostomies are not 100 per cent good. They, therefore, feel that a gastro-enterostomy is scarcely ever indicated in acute perforations. The degree of occlusion of the pylorus must be judged by its condition before the closing sutures are placed, not afterward. It is very improbable that a closure by sutures will persist. We all know how extremely difficult it is to close the pylorus by operative procedure.

DR ROBERT T. MORRIS emphasized two points, one practical and the other theoretical. Nothing was said in the paper about patients in shock or bad condition when first seen. In those cases one should not stop even for simple suture but make immediate incision, put in a drain, do nothing more and discover how surprisingly many will recover from a ten-minute operation particularly if this is followed by the Ochsner starvation treatment. As to the theoretical point, it was a source of wonder to Doctor Morris that Rosenow's theory of elective affinity for toxins was not held in greater respect. It gives a working theory for duodenal and gastric ulcers. If there is toxic blocking of any terminal artery the circulation is shut off. That

area representing the terminal artery is then exposed to bacterial and digestive processes. There may be overaction of antibodies. With that in mind, why may one not have a clear enough picture of the etiology of duodenal and gastric ulcer? There is little mystery above their occurrence so far as Doctor Morris looked at the matter.

DR RALPH COLP reported thirty-four cases of perforated duodenal ulcers from the surgical service of the Beekman Street Hospital. Two-thirds of these were gastric in origin, and one-third duodenal, and all occurred in males.

The patients were operated as soon as possible after admission and the surgical procedure in all was that of simple closure of the perforation. It was felt quite strongly that this was all that was necessary inasmuch as the chances of narrowing either the duodenum or pylorus to such a degree that an acute obstruction would result, was almost impossible, and even if this untoward complication should occur, gastro-enterostomy could always be done within twenty-four hours. In addition, it has been shown that gastro-enterostomy is often accompanied by subsequent gastro-jejunal ulceration, some clinics reporting this complication as high as 33 per cent.

Intra-peritoneal drainage was never employed, and in a few selected cases a piece of rubber dam was placed down to the peritoneum to take care of possible abdominal wall infection.

While a great majority of these cases were done within an eight-hour period, there were several which were operated as late as twenty-four hours after perforation.

In this series of thirty-four cases, there were two deaths, making a mortality of 6 per cent. One of these patients died from a spreading peritonitis, and the other, although operated under spinal anæsthesia, died within twenty-four hours from an acute collapse of the lung.

DOCTOR DINEEN, in closing the discussion, said that his paper represented the experience of the men on the Second Surgical Division of the New York Hospital. He knew that many excellent surgeons were doing gastro-enterostomies and publishing splendid results. He considered that Doctor McCreery had summed up the subject very well and his indications would cover almost any case. As to Doctor Colp's remarks, Doctor Dineen felt that his mortality of 6 per cent was remarkable. As to the question of drainage, he drained through the peritoneum where there was an excessive amount of fluid, but ordinarily drainage was done down to the peritoneum. As to Doctor Morris' point regarding shock, most of these patients when admitted are suffering with an acute peritonitis and naturally the treatment of shock must be considered. His own impression was that in these acute perforations the initial condition is not what is generally thought of as shock. It is rather an acute inhibition. Regarding the theoretical point, Rosenow's theory is a very important one and has received much consideration but as to the exact etiology the speaker knew nothing. Regarding Doctor Hinton's observations as to the difference between duodenal and gastric ulcers, Doctor

PERFORATED ULCERS OF THE STOMACH AND DUODENUM

Dineen said he had tried to make this differentiation in a previous study. Most of the perforations took place in or about the pyloric vein but with the acute inflammatory reaction it was hard to say which side it was on. About four of the duodenal ulcers to one of the gastric had been the approximate observations. As to recurrence of symptoms, it was questionable if anyone was ever really cured of gastric or duodenal ulcer, it was probable that they need always to be under treatment. Regarding Doctor Lewisohn's suggestion as to the gastric symptoms lasting a long time, and the question of diet, Doctor Dineen believed these patients must always be kept under observation. He remembered a case of Dr. Charles Peck, free from symptoms for eighteen years and then re-operated. As to the follow-up of these cases they do have definite spasm which disappears a little later. As to whether this is pyloric spasm or a nervous symptom is not known, they have been offered surgery but have refused. As to resection Doctor Dineen had no experience. Dr. McCreery's remarks were very interesting and Doctor Dineen believed that duodenal ulcer with excessive obstruction of the pylorus was an indication for gastro-enterostomy. Regarding Doctor McCreery's observations on the relation of alcohol to these perforations, Doctor Dineen's experience had been the exact opposite inasmuch as few of his cases of perforated ulcer gave an alcoholic history.

BRIEF COMMUNICATIONS

TRAUMATIC ANEURISM OF THE SUBCLAVIAN ARTERY

WITH COMPLETE BRACHIAL PLEXUS PARALYSIS

THE following case is of interest because of the comparative rarity of traumatic aneurism of the subclavian artery and the subsequent pressure paralysis of the brachial plexus

J S, a negro boy of eighteen, was first seen April 15, 1924. His complaint at that time was inability to use his right arm and hand. Two weeks previously he had been stabbed in the right side of his neck with a knife. The wound, which was 2 cm long, was located just above the middle of the clavicle. At the time of the injury the wound bled profusely, but the hæmorrhage was controlled by pressure and by suturing the skin. Twenty-four hours later a numbness was noticed in the hand, and in forty-eight hours the arm, forearm and hand were numb and paralyzed.

Examination showed a complete sensory and motor paralysis of the whole right upper extremity, except for an area of normal sensation over the shoulder cap and an ability to partially externally rotate the arm. The wound

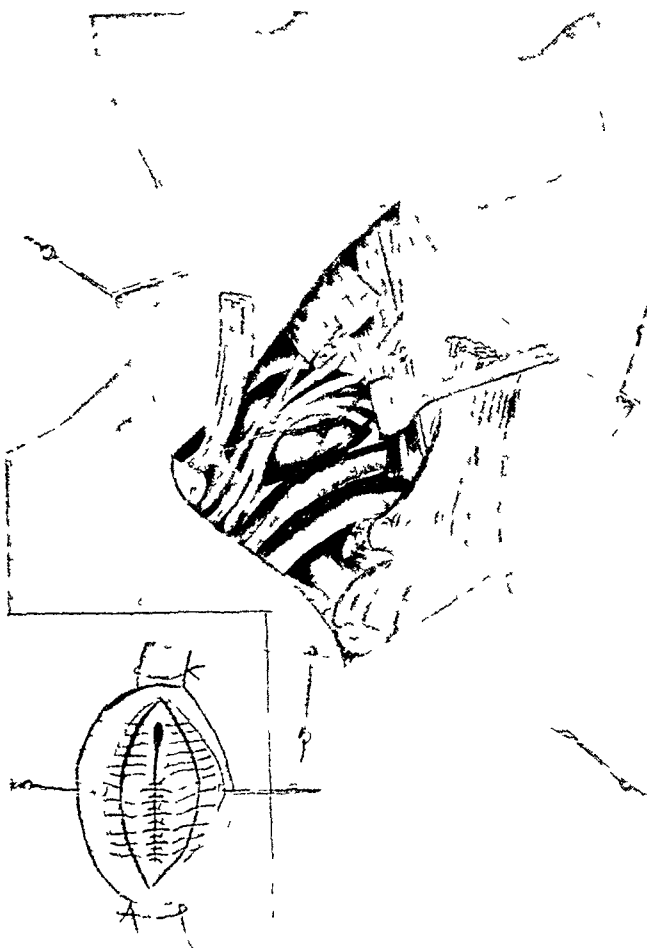


FIG 1.—Drawing showing the aneurism in the second portion of the subclavian artery. The nerves of the brachial plexus are shown stretched across the sac. Exposure was obtained by removal of the clavicle and division of the sternomastoid and omohyoid muscles. Insert shows method of obliteration of the aneurism.

in the neck was well healed but directly beneath it an expansible tumor about 3 cm in diameter could be felt. A distinct systolic thrill and bruit could be detected over the tumor. The blood pressure in the two arms was the same, systolic 115, diastolic 85.

It was believed that an aneurism of the subclavian artery was present and that the paralysis of the upper extremity was due to pressure, since the latter did not appear until twenty-four hours after the injury and was progressive rather than abrupt, as would have occurred in case the nerves of the plexus were severed.

ANEURISM OF SUBCLAVIAN ARTERY

Operation was performed under ether anæsthesia May 6, 1924, five weeks after the injury. An incision was made over the clavicle and the middle three-fourths of it removed. Another incision was made upward from the clavicle along the posterior border of the sternomastoid muscle. Skin flaps were raised and the deep fascia of the neck incised. The subclavian artery and vein were identified and the aneurism was found arising from the artery at the outer border of the anterior scalene muscle.



FIG 2a and b—The patient two years after operation, showing normal muscular development of the right extremity and normal movements.



FIG 2b

ished. Within two weeks there was a return of sensation over the thumb and radial side of

The three trunks of the brachial plexus, which were stretched tightly across the aneurism, were dissected free from it. The anterior scalene muscle was retracted medially in order to reach the second portion of the subclavian artery, which was then ligated with heavy braided silk. The artery was ligated distal to the aneurism in the same manner. The sac was opened and the wound in the artery, about 1.5 cm long, disclosed. An obliterative aneurismorrhaphy was then done with interrupted sutures of fine silk. The transverse cervical and transverse scapular arteries were encountered as they ran across the brachial plexus and care was taken not to injure them since the main anastomotic circulation was carried through them. The trunks of the brachial plexus, which were held away from the operative field, were replaced and the wound closed without drainage.

Following the operation, there was an obliteration of the brachial and radial pulse, but the arm and hand remained warm and well nour-

the arm and hand, and in three weeks sensation throughout the extremity was practically normal. In four weeks, motion returned in the biceps, followed shortly by motion in the triceps and extensors and flexors of the wrist and fingers. Motion returned last to the lumbrical and interosseous muscles, but within a year all motion was normal. The loss of a greater portion of the clavicle caused no disability either in motion or strength.

Comment—Complete sensory and motor paralysis of the upper extremity due to pressure of traumatic aneurism of the carotid artery is unusual and following injury is usually incorrectly diagnosed as a primary nerve lesion. In this case the onset of the paralysis, twenty-four hours after injury, indicated that nerve lesion was due to pressure rather than actual interruption. Sensation was interfered with first and was the first to return after release of pressure. The lower trunk of the plexus was first affected, and since subjected to the most trauma by reason of its position, was the last to return. Removal of the greater portion of the clavicle had no appreciable effect on either motion or strength of the extremity.

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TRAUMATIC RUPTURE OF HYDRONEPHROTIC KIDNEY

IN 1927 Herman¹ reported a case of "Ruptured Hydionephrosis." He demonstrated a rent in a hydionephrotic sac by urography, and considered this the only instance of preoperative urological diagnosis of this condition. Because of its rarity and interest the following case is published.

R. M., age eighteen, was referred by Dr. Bruce Brockway, of Toledo, Ohio, with the following history: About four o'clock on the afternoon of February 2, while coasting, the patient fell from a sled and struck his left side against a concrete block. He was taken to his home in a semi-dazed condition. He complained of severe pain in the upper left portion of his abdomen. About an hour later he urinated bright red blood. He was immediately taken to The Flower Hospital. His past medical history was negative except for the usual diseases of childhood, including scarlet fever, and the fact that as long as he could remember he would have occasional attacks of slight pain in the left portion of his abdomen. Examination of his urine was always reported to be negative, with the exception of one instance five years ago when albumin was found, and he had had no urinary symptoms. His family history was negative.

Examination at the hospital revealed the following: The patient was a young boy apparently in some shock. The mucous membranes were blanched, the lungs normal to auscultation and percussion, the heart sounds normal. The pulse was 80, blood pressure 100 systolic, 80 diastolic. There was some rigidity and tenderness of the upper left portion of the abdomen, also tenderness in the left costo-vertebral angle. There was a suggestion of a mass in the left lumbar region. It was impossible to determine the presence of fluid in the abdomen. The liver and spleen were not palpable. The external genitalia were normal. A small catheter was passed into the bladder and almost pure blood obtained. Because of this it was thought best to cystoscope the patient.

At 8 P.M. of the day of the injury a small size cystoscope was passed easily into the bladder. The bladder wall appeared normal throughout. The right ureteral opening was normal, and clear spurts of urine were seen to issue from it. The left ureteral opening

RUPTURE OF HYDRONEPHROTIC KIDNEY

was very small, and several bloody spurts appeared from it. A small catheter was passed up the left ureter without difficulty. From this very bloody urine was obtained fifteen c.c. of a 12 per cent sodium iodide which were injected gently into the catheter. The resulting pyelogram had the following appearance. The ureteral catheter made a direct turn back upon itself in the lower portion of the ureter. The ureter throughout was markedly widened and tortuous. The lower calyx was partially filled and there was considerable amount of the iodide solution extravasating about the kidney.

Following cystoscopy the patient seemed to be in good condition. Four hours later he was reacting nicely from shock. On the following day he was quite comfortable, and his pulse was good. Examination of the blood at this time showed the hemoglobin to be 55 per cent, red blood count 2,850,000, white blood count 15,300, with 87 per cent polymorphonuclear leucocytes, and blood urea nitrogen 17 mg. for 100 c.c. of blood. The urine obtained from the left kidney showed very many red blood cells, five to ten white blood cells per high power field, and a culture showed no growth. The following afternoon the patient developed severe pain in the left side of the abdomen. Dullness could be elicited in the left flank, which was not movable on tilting the abdomen. A tender mass could be palpated in the left iliac fossa, and there was an increase in the tenderness of the perirenal space. There was no acceleration of the pulse rate, nor drop in the blood pressure.



FIG. 1.—Urogram of left kidney and ureter.

It was considered at this time that the patient was suffering with a recurrence of the bleeding, with an extension of the blood downward behind the peritoneum towards the pelvis. A diagnosis of rupture of an old hydronephrotic kidney, with hæmorrhage and extravasation of urine, was made, and operation performed immediately. Under gas oxygen anaesthesia a large left kidney incision was made according to the method of W. J. Mayo, exposing the perirenal capsule. All of the tissues were oedematous. The fatty capsule was incised and a large amount of blood gushed into the wound. The renal pedicle was secured with the left hand after fracturing the twelfth rib, and a large pedicle clamp applied. The kidney was then seen to be markedly enlarged, and severely lacerated through its mid portion. The pedicle was then severed and the kidney removed. Three cigarette drains and a strip of iodoform gauze were used for drainage. The wound was closed with running sutures of catgut. The patient left the operating room in fair condition. The pedicle clamp was loosened on the fourth day and removed on the fifth.

The pathological report was as follows. Specimen consists of several large pieces,

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the total weight being 430 gms. Cut surface presents an honey-comb appearance, there being several large cysts surrounded by very thick fibrous tissue. There are quite a few hæmorrhagic areas. The cysts contain, in addition to pus, some more or less necrotic kidney tissue. Pathological diagnosis: Old hydronephrosis with fibrosis and degeneration of parenchyma. Traumatic rupture of kidney. Pyonephrosis.

On the day following operation the patient's condition was good, temperature 100, pulse 90, respiration 18, with urine containing albumen, but negative for pus or blood. All drainage was removed by the tenth day. February 16, 1929, the hemoglobin was 52 per cent, red blood count 2,670,000. There was an afternoon rise of temperature to about 101. Drainage from the wound was sero-sanguinous. By March 16, 1929, the wound was almost healed, and the patient was walking about and feeling much stronger. The hemoglobin was 60 per cent, red blood count 3,040,000, blood urea nitrogen 14 mg per 100 c.c. The patient was discharged from the hospital. On August 20, 1929, he felt well, and had no urinary symptoms. He was able to carry out his usual work without fatigue. His weight was 150 pounds (weight before injury, 148 pounds). The urine examination was negative except for an occasional white blood cell. The blood urea nitrogen was 12 mg per 100 c.c. of blood.

The advisability of urography in rupture of the kidney or ureter is questionable. In this instance no harm could be traced to it, and the pathological condition was ascertained before operation. If the rupture was known to extend into the peritoneum, urography would seem to be contra-indicated.

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A SUBCUTANEOUS FASCIAL STRIPPER

IN RECENT years living fascia has been used increasingly in a variety of operations. Several years ago the writer was told that fascial strips for use in

hernial repair could be obtained by means of the Mayo stripper. Efforts made with this instrument resulted so unsatisfactorily that it was determined to make a special instrument somewhat on this principle which would give adequate strips for use in any desired surgical procedure. On this account a fascial stripper was made that has been used by various surgeons on different services of Bellevue Hospital with satisfactory results. The instrument is made with a long handle like a vein stripper. The lumen is, however, rectangular. The edges of the lumen are sharp, except the posterior one. The strippers are made with different size lumena. The smallest size will cut adequate strips for the fascial repair of any hernia. The medium size will cut a strip which can

be divided longitudinally into about three strips of requisite width as a rule. The measurements of the strippers are as follows

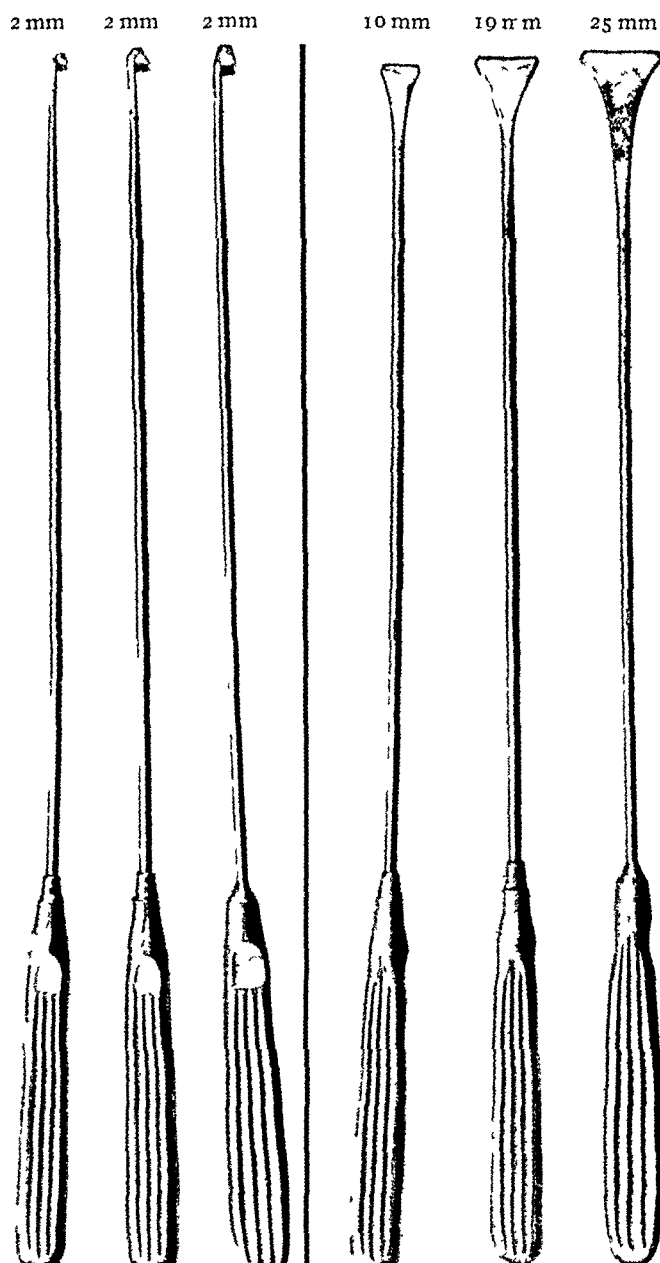


FIG. 1.—The illustration shows three different sized strippers

Over length	14½ inches
Length not including handle	9¾ inches
Size of openings	
Small	2 x 10 mm
Medium	2 x 19 mm
Large	2 x 25 mm

BRIEF COMMUNICATIONS

The width of 2 mm is just sufficient to accommodate the thickness of the fascia lata

The method used by us has been as follows. A small transverse incision is made on the outer femoral region just above the line of the knee-joint and the ilio-tibial band is exposed. Its outer and inner surfaces are cleaned of attached tissue and, with a knife, strips of 10 mm or 19 mm wide are started if either the small or medium strippers are used. These strips are dissected for about 3 or 4 cm of their length and are then threaded through the appropriately sized stripper. A Kocker clamp is used to hold these threaded ends and the stripper is pushed upward along the outer thigh for the required length. A longitudinal small counter incision is made down to the fascia and after it is severed transversely it can be drawn by the Kocker clamp through the lower wound. Any number of strips can be obtained in this way. The advantages of this method are obvious.

It makes it possible to do away entirely with the surgical assistant employed in the older method of obtaining these strips. It makes the procedure relatively minor. It cuts down the operating time. It gives the patient two small scars, a lower transverse and an upper longitudinal instead of the usual long unsightly scar. It reduces the possibilities of infection because of the above factors.

The instruments are made by George Tiemann & Company, New York, N. Y.

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CARCINOMA OF THE APPENDIX*

CARCINOMA of the appendix is not a great rarity, but it is a condition that occurs with such relative infrequency, that one is warranted in reporting a case. The incidence of occurrence is varyingly stated, but the average of several statistics studied is 0.39 per cent of all appendices removed. It is usually an accidental pathological finding and is removed in the course of a laparotomy performed for some other reason.

The cases reported in this paper show atypical clinical pictures of appendicitis and a differential diagnosis was quite difficult.

CASE I—C. F., white, female, single, age twenty-three years, was admitted to the New York Post Graduate Hospital March 13, 1929. Her chief complaint was indigestion, characterized by nausea, but no vomiting, and pain in the abdomen localizing. Latterly the attacks have occurred with greater frequency and intensity. There has been some dysuria, but no hematuria.

Her temperature was 99. Pulse—90. She was thin and poorly developed. The only noteworthy fact was some tenderness low down in the right lower quadrant, below McBurney's point. There was no hernia. Some right kidney tenderness. No vaginal examination. Rectal examination negative.

* From the Surgical Service of Dr. Charles Gordon Heyd, New York Post Graduate Medical School and Hospital.

CARCINOMA OF APPENDIX

An X-ray showed at the level of the lumbo-sacro joint about 6 cm to the right of the median line a shadow $1\frac{1}{2}$ cm in its long diameter, and 1 cm in width, of rough and irregular appearance. The absence in the history of hematuria or renal colic caused the shadow to be construed as that of a calcified lymph node, and not ureteral calculus.

Operation—(by Dr Moolten) March 15, 1929

The abdomen was entered through a right paramedian incision. The appendix was congested, tumefied, and wrapped in omentum. The adhesions separated easily, indicating a recent inflammatory process. A typical appendectomy with inversion was performed, and the abdomen closed without drainage.

On section, the tip of the appendix appeared to be calcified to the extent approximately of the size of the X-ray shadow. The rest of the mucosa was thickened and necrotic.

Report of Tissue Examination (by Dr Nicholas N Alter Lab No 10965-38881)

Appendix measures 4 cm in length. It has been opened and measures 2 cm in width. The wall is greatly thickened and averages 8 to 9 cm in thickness. The distal end consists of several yellowish gray rather firm nodules which measure from 5 to 12 cm in diameter. The serosa contains a few fibrous tags.

Microscopic—Section through the tip of the appendix shows the mucosa replaced by an epithelial growth which is arranged in irregular strands, some places resembling glandular tissue. There is an occasional mitotic figure seen. In one place a few strands of epithelial growth are seen in the muscular tissue but in most parts of the section the growth seems to be limited by the muscularis mucosa.

Sections from the lower portion of the appendix show some remaining mucous membrane which is lined by high columnar epithelium, but there are numerous old ulcerated areas which are partially covered by regenerated epithelium. Beneath this, some old granulation tissue can be seen and in areas there is rather rich infiltration with lymphocytes and plasma cells. The submucosa is greatly thickened and fibrotic. The inflammatory infiltration extends entirely through the muscular layer and the serosa which is markedly thickened and shows rather rich inflammatory infiltrations. There are also numerous congested blood vessels in the serosa.

Diagnosis—Carcinoid of appendix with chronic inflammatory changes.

NOTE—This is a benign type of epithelial growth which does not tend to metastasize.



FIG 1—Carcinoma of appendix vermiciformis (Case I)

BRIEF COMMUNICATIONS

CASE II—A thin, poorly developed white woman, married, age twenty-five years, was admitted to hospital on account of pain in right side which had been more or less constant for one year. Occasional indigestion and vaginal discharge since onset of pain. Loss of weight probably due to failing appetite. For past two weeks pain has been worse and she has not been able to work. Except for tonsillectomy five years ago, her past history is not significant. Menstruation has been regular in occurrence, but during the past year has tended to be more copious in amount, and has changed from a four to five day duration. Her temperature was 98.8. Pulse—80.

Abdominal examination revealed some tenderness over McBurney's point. Vaginal examination. Retroversion of uterus. Rather copious mucoid discharge. Smear did not reveal any Neisserian organism. Extreme tenderness in the right fornix.



FIG. 2.—Carcinoma of appendix vermiformis (Case I.)

Abdomen was closed without drainage. The tip of the appendix was noticed to be bulbous and hard.

Report of Tissue Examination—(By Dr. Nicholas M. Alter, New York Post Graduate Hospital—Lab. No. 16825-39411.)

Appendix measures 7 cm. in length. The tip is swollen and covered with a great deal of hæmorrhage. The tip measures 12 cm. in diameter. On section of the lower third, the mucosa is lifted in thick folds and has a light yellow appearance. The wall is uniformly thickened, although the muscle layer seems to cover the growth. The serosa above it is somewhat congested. The mucosa above the polypoid growth is smooth and somewhat swollen. It is covered with some hæmorrhagic mucus.

There are no curettings with the specimen.

Microscopic—Section of appendix shows part of the glandular lining of the appendix in transition to an epithelial growth which consists of small dark cells arranged in small

FRACTURE OF CORACOID PROCESS OF SCAPULA

groups. They seem to extend to the muscle layer uniformly. One section, however, shows some invasion of the muscle tissue. The nests of epithelial cells are surrounded by lymphocytes. The surrounding stroma also contains numerous blood vessels and lymph vessels. In some of the nests, glandular arrangement is suggested. In other portions the cells are more elongated.

Diagnosis—Carcinoid of appendix.

NOTE—This is a typical case of the benign type that is also called "endothelioma."

Comment—Carcinoma of the appendix is a distinct clinical entity. It occurs most often at the tip and is always benign. The lack of malignancy is obvious as metastasis does not occur. In many cases, the origin has been demonstrated to be not from the epithelium at all, but from blood vessels. This would constitute, actually, a benign endothelioma.

There is another type of case in which a malignant tumor occurs at the proximal end of the appendix. This is not, strictly, a carcinoma of the appendix, but finds its origin in the cæcum or ileocecal valve. These tumors metastasize and demonstrate all the characteristics of other intestinal malignancies.

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FRACTURE OF THE CORACOID PROCESS OF THE SCAPULA

CASE REPORT—Mrs. E. C. was referred by Dr. T. D. Bourdeaux July 24, 1929, for treatment of an injury of the left shoulder sustained twenty-four hours previously in an automobile accident. Examination revealed slight lacerations of the right leg and the injury to the left shoulder which is here described. The left arm was held firmly to the side, with the forearm flexed, by the right hand and arm. Constant pain in the shoulder had been experienced since the injury and motion of the arm in any direction caused great pain. There was some swelling of the infraclavicular, the acromial and the deltoid regions of the shoulder and pressure over the acromial and infraclavicular regions caused severe pain.

X-ray of the left shoulder (Fig. 1) showed a deformity of the coracoid process of the



FIG. 1.—Showing deformity of the coracoid process and fracture through the base of the scapula.

scapula with evidence of a fracture at the base of the coracoid. The base of the coracoid was displaced upward and the tip of the coracoid pulled downward and forward.

A plaster spica was applied to the shoulder, extending to the metacarpo-phalangeal articulation, with the arm abducted and rotated inward, the forearm flexed to an

angle of ninety degrees, and the thumb pointing toward the nose. After the application of the bandage the pain in the shoulder was relieved. The plaster was allowed to remain for four weeks, at which time baking and massage was instituted and active motion encouraged. Examination at the end of six weeks showed good union with no limitation of motion in any direction.

Discussion—Very little has been written on coracoid fractures. In a review of the literature since 1919 no articles on this subject were found. However with the increasing number of automobile and industrial accidents this fracture evidently occurs more frequently than is presently supposed and much oftener than is recorded in the literature.

Eliason mentions coracoid fractures as follows: "The coracoid has been reported broken but rarely, and then usually as a complication. Muscular action has caused it. The diagnosis is confirmed by the roentgen-ray. Treatment is best with the Velpeau bandage. Fractures of the coracoid process, if uncomplicated, are very difficult to interpret. The stereoscope is indispensable here."

It is to be remembered that the tendons of origin of the short head of the biceps and the coracobrachialis are attached to the tip of the coracoid process, the actual tendon of the biceps passing deep down between the flexor and radial groups of muscles being inserted into the tuberosity of the radius. The coracobrachialis is inserted into the anterior and internal surfaces of the humerus at about its middle, and into the internal intermuscular septum.

In view of the anatomy involved, and since in my case pain, which was an important factor, was almost immediately relieved by the immobilization in the plaster, it appears to my mind that these fractures are best treated by a plaster spica of the shoulder applied with the arm abducted and rotated inward, the forearm flexed at a ninety degree angle and the thumb pointing toward the nose.

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GAS GANGRENE OF THE ABDOMINAL WALL FOLLOWING GANGRENOUS APPENDICITIS

Gas gangrene of the abdominal wall is an extremely rare condition and on account of its rarity and of its very serious nature a fatal case is reported in this communication.

Gas gangrene is produced clinically by several of the anaerobic organisms very often mixed with streptococci, but the *Bacillus aerogenes capsulatus* or *Bacillus welchii* is perhaps the most important. Infection of traumatic wounds by the *Bacillus welchii* is not rare, particularly in the agricultural districts, and of course during the World War it was not an unusual complication.

Most of the infections with the anaerobic organisms following abdominal operations are the result of the presence of the organisms in the pathologic process or due to its presence in the intestinal tract and not due to any contamination from without as are those following the traumatic cases.

GAS GANGRENE FOLLOWING APPENDICITIS

It has been shown that the *Bacillus welchii* is quite a common inhabitant in the intestinal tract and, in fact, the organisms have been found in the blood of patients who did not show much clinical evidence of having a septicemia except for a clinical picture simulating that of pernicious anaemia.¹ Several investigators have shown the presence of the *Bacillus welchii* in quite a high percentage of appendiceal abscesses, Welch,² Flexner,² Wright² and Stokes² finding it in 22 per cent of the peritoneal exudates following peritonitis which they examined. Butler³ was unable to demonstrate the *Bacillus welchii* in his bacteriological studies. These included studies of appendices removed at operation, appendiceal abscesses, studies of large gut and ileum, and studies of free pus in the peritoneal cavity. Many of the cases reported as gas gangrene or emphysema of the abdominal wall were not checked by bacteriologic studies of the wounds, nor by blood cultures. Consequently, it is difficult to get from the literature, a true picture of the frequency or course of gas gangrene produced by an anaerobic organism.

Despite the wide divergence of data it is quite apparent that the *Bacillus welchii* is an inhabitant of the intestinal tract in a small percentage of people and occasionally asserts itself as the cause of a pathological process. Just why this organism suddenly becomes so virulent is amazing, particularly in view of the fact of its widespread distribution. It has been recognized for a long time that it grew anaerobically on gangrenous tissue and it is logical that the gangrenous appendix offers an ideal culture medium for its growth. Acute gangrenous appendicitis is perhaps the most frequent abdominal condition following which the *Bacillus welchii* manifests itself in the form of gas gangrene, but gas gangrene has been reported as a complication following operations for perforated gastric and duodenal ulcers, following cholecystectomy, following enterostomy and following criminal abortion.

In reviewing the cases of gas gangrene following operations for gangrenous appendicitis, it is quite evident that there are two types of cases, one with the process a localized one, and the other one a localized infection with a general septicemia. It is hard to gather from the literature how many of the cases reported had a septicemia, as the blood cultures are not reported, but it is quite probable that the fulminating type going on to rapid death is accompanied by a blood-stream infection of the *Bacillus welchii*. This was true in the case reported below and in reviewing this case it is quite evident that the man had a blood-stream infection from the beginning of his illness.

If the condition is localized in the abdominal wall the treatment consists of wide and multiple incisions over the site of the involved region, combined with the administration of Bull's serum, but in the fulminating type, such as reported below, apparently any method of treatment is futile. This patient showed evidence of a profound toxemia from the very first and the subcutaneous oedema first appeared in the axilla, both of which were evidence of a blood-stream infection, or, at least, of a generalized infection.

It should be emphasized that gas gangrene of the abdominal wall does respond to wide incision and drainage in enough cases to warrant this radical

procedure, provided of course the patient's general condition will permit of the treatment. The extent of the infection is the determining factor in the prognosis. Ochsner⁴ reports a case which responded to wide incisions of the abdominal wall and treatment of the open wound with Dakin's solution. Butler³ reports two cases, one recovering after wide drainage of the abdominal wall, and the other terminating fatally in ninety-six hours. Baldwin and Gilmons⁵ in 1927 collected eleven case reports of gas gangrene following gangrenous appendicitis, but the mortality of these cases is not given.

CASE REPORT—The patient, a man sixty-one years of age, was seen at 10 P.M. June 29, 1929, in consultation with Doctor Savage. At this time the following history was obtained. The patient, an office man by occupation, had enjoyed fairly good health except for several attacks of dizziness and headache which were attributed to high blood pressure. He had had repeated attacks of right-sided abdominal pain which had been diagnosed as renal colic.

Present Illness—The present illness began twelve hours before patient was seen by me, at which time he was seized with a severe abdominal pain, mostly in the right lower quadrant and in the right back. This was accompanied by nausea and vomiting. There had been moderate constipation prior to this attack. The patient was seen shortly after the onset of the illness by Doctor Savage, who on examination found the patient's pulse and temperature normal, with some abdominal tenderness but the tenderness was chiefly in the right flank. Eight hours after the onset of the attack the temperature was 101° and the pulse 100, and the pain was worse in the right flank. The nausea had persisted. At this time a urine examination showed the urine negative except for a slight amount of albumin, and the white blood count was 16,000. The patient was then sent to the hospital, at which time I saw him and the following was noted.

Physical Examination—The patient was a rather obese and plethoric man. Temperature 101.5°, pulse 100, blood pressure 160/80. The general physical examination was essentially negative except for moderate cyanosis. The abdomen was distended and there was extreme tenderness on pressure accompanied by muscle spasm over the right lower quadrant and right flank. No masses were made out. Peristalsis was diminished but present to some extent. The diagnosis of acute appendicitis with which the patient was sent to the hospital was confirmed and immediate operation advised and done.

Operation—Under spinal anaesthesia a McBurney incision, quite lateral, was made and the appendix was found to be retrocaecal in position, gangrenous and quite adherent to the parietal peritoneum and caecum by old inflammatory adhesions. There was no perforation of the appendix and no evidence of any localized or general peritonitis. The appendix was removed, the base inverted in the usual manner and the wound closed after thorough irrigation with salt solution, a practice which is always carried out in all acute cases.

The patient stood the operation quite well and was in good condition when he returned to his bed.

Post-operative Course—Twelve hours after the operation the patient's condition was quite satisfactory but during the second twelve hours his temperature went to 103.5° and the pulse to 130. With this there was marked abdominal distention, and marked restlessness with periods of delirium. The peripheral circulation was poor and there was considerable cyanosis. From this time on all of these untoward symptoms increased and did not respond to the usual methods of treatment. A large amount of salt solution was given as a continuous slow hypodermoclysis and glucose and soda was given by rectum. The abdominal distention persisted although the patient passed a large amount of gas with enemata. Gastric lavage showed no dilatation of the stomach and gave no relief.

GAS GANGRENE FOLLOWING APPENDICITIS

Inspection of the wound thirty-six hours after the operation showed some œdema but no pus. A probe inserted through the skin edge at this time revealed no pus.

At this time (thirty-six hours after operation) the patient complained of pain in the right axilla and there was already some swelling in this region. A few hours later the swelling in the axilla showed definite crepitus and at this time (forty hours after operation) the wound was again inspected and thin yellowish pus was found on inserting a probe through the skin edge. The crepitus in the axilla ended at the costal margin and did not extend to the area of the wound. There was considerable œdema of the wound but no bronzing of the skin. A smear taken from the wound showed a pure culture of the *Bacillus welchii*. A blood culture taken at the same time also showed a pure culture of the *Bacillus welchii*.

The patient's general condition became rapidly worse and he died forty-four hours following the operation. He remained conscious until almost the end except for short periods of delirium during the second twenty-four hours. Autopsy was asked for but not obtained.

JOSEPH P SHEARER, M D
Washington, D C

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MEMOIR

FRANK EMORY BUNTS, M D

1861-1928

DR FRANK EMORY BUNTS died suddenly from heart disease on November 26, 1928. His departure brought a deep sense of loss not only to his many friends and associates among the physicians of Cleveland, but also to physicians, friends, and former patients throughout the world, who have

at some time come under the influence of his kindly and genial spirit.

Doctor Bunts was born in Youngstown, Ohio, in 1861, and received his education in the public schools. He then received an appointment to the United States Naval Academy at Annapolis, from which he was graduated in the class of 1881 which produced many other prominent men among them Senator Weeks, Senator Weller, of Maryland, and Baron Uriu, who was



DR FRANK E. BUNTS

Vice-Admiral of the Japanese Navy when Doctor Bunts visited Japan in 1922.

After Doctor Bunts had served for two years with the Asiatic fleet, the opportunity was given the younger naval officers to resign, because the Navy was overstaffed, and Doctor Bunts decided to leave the Navy and to study medicine, but all through his life and in all his relations he always bore the stamp of the Navy.

He matriculated in the Western Reserve Medical School and was graduated with the class of 1886. After graduation he became house officer at St. Vincent's Charity Hospital, with which institution he was associated in various capacities for the rest of his life—forty-two years.

In 1887 Doctor Bunts became the assistant to Dr. Frank Weed, who had a very active general practice on the west side of the city, including a great deal of casualty work. It was at this time that Doctor Bunts became interested in surgery. Doctor George W. Cile joined them in 1889 and after the

death of Doctor Weed in 1891 he and Doctor Bunts continued to practice together, associating with them in 1894 Dr Wm E Lower .

Twice Doctor Bunts interrupted his practice to go abroad to study at foreign clinics, and later, during the Spanish War, he enlisted in the Army, serving as surgeon to the First Regiment of Ohio Cavalry under Major Runcie. He always retained his interest in military matters and after the war was over, in the midst of a busy practice, he became captain of Troop A and served in this capacity for three years. At the time of the World War he again accepted a commission as major, later becoming lieutenant-colonel and commanding General Hospital No. 9 at Rouen, France (Base Hospital No. 4, U. S. Army).

Doctor Bunts was a member of the Cleveland Academy of Medicine from the time of its organization in 1902, and was its first president. He was also a member of the Cleveland Medical Library Association, serving as its president in 1927. He was a member of the American Surgical Association, the Ohio State Medical Society, the American Medical Association, the American College of Surgeons, the American Association for the Prevention of Cancer, the Société Internationale de Chirurgie, and the Société Française pour l'Avancement de Science.

From 1886 to 1893 Doctor Bunts lectured on surgery at Wooster Medical College, and from 1893 until the time of his death he was Professor of Principles of Surgery and Clinical Surgery at the Medical School of Western Reserve University. He was visiting surgeon at various times to St. Alexis Hospital, St. Anne's Maternity Hospital, Mount Sinai and Cleveland City hospitals, consulting surgeon to the Lutheran, Women's and Maternity hospitals. He was one of the founders of the Cleveland Clinic Foundation and was chief of staff at St. Vincent's Charity Hospital from 1913 until his death.

Among Doctor Bunts' salient characteristics was his deep interest in civic and national affairs. He was a member of the Chamber of Commerce and served for years on its Committee on Military Affairs. He was a director of the Cleveland Trust Company. He was interested in and furthered every movement for civic improvement and was a frequent lecturer on patriotic subjects. He was a man of broad culture and wide reading, especially interested in articles and books bearing upon early medical history. In medical articles, many of which he was the author, and in the small volume of stories which he published some years ago his writing always showed a characteristic individual charm. He was a practitioner of the gentle art of fishing and the month each year spent at Rose Point provided many anecdotes which were a constant delight to his friends.

In 1888 Doctor Bunts was married to Miss Harriett E. Taylor and they were the parents of Dr. Alexander Taylor Bunts and of Clara Louise Bunts, wife of Edward C. Daoust .

It is difficult properly to evaluate this man. He possessed so many characteristics which make for greatness combined with a retiring, unassuming per-

GEORGE W CRILE

sonality Perhaps one may safely state that the keynote of his character was constancy—once he made up his mind to devote himself to any institution or cause, that cause or institution had his unfailing loyalty ever after Every one of his patients became his lifelong friend in whose welfare he never failed to keep a lively interest

An emphatic word should be added about his influence as a teacher upon the hundreds of students with whom he came in contact in the medical school and in the wards of the hospital Patience and understanding, with insistence upon accuracy in diagnosis and refined surgical technic in operating, were outstanding characteristics of Doctor Bunts, the teacher

There are certain individuals who possess the rare quality of binding together those with whom they are associated, due to high intelligence, industry, uncompromising justice, fidelity, patience, a deep understanding of human frailties, and unfailing friendliness Such a man was Doctor Bunts

GEORGE W CRILE

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